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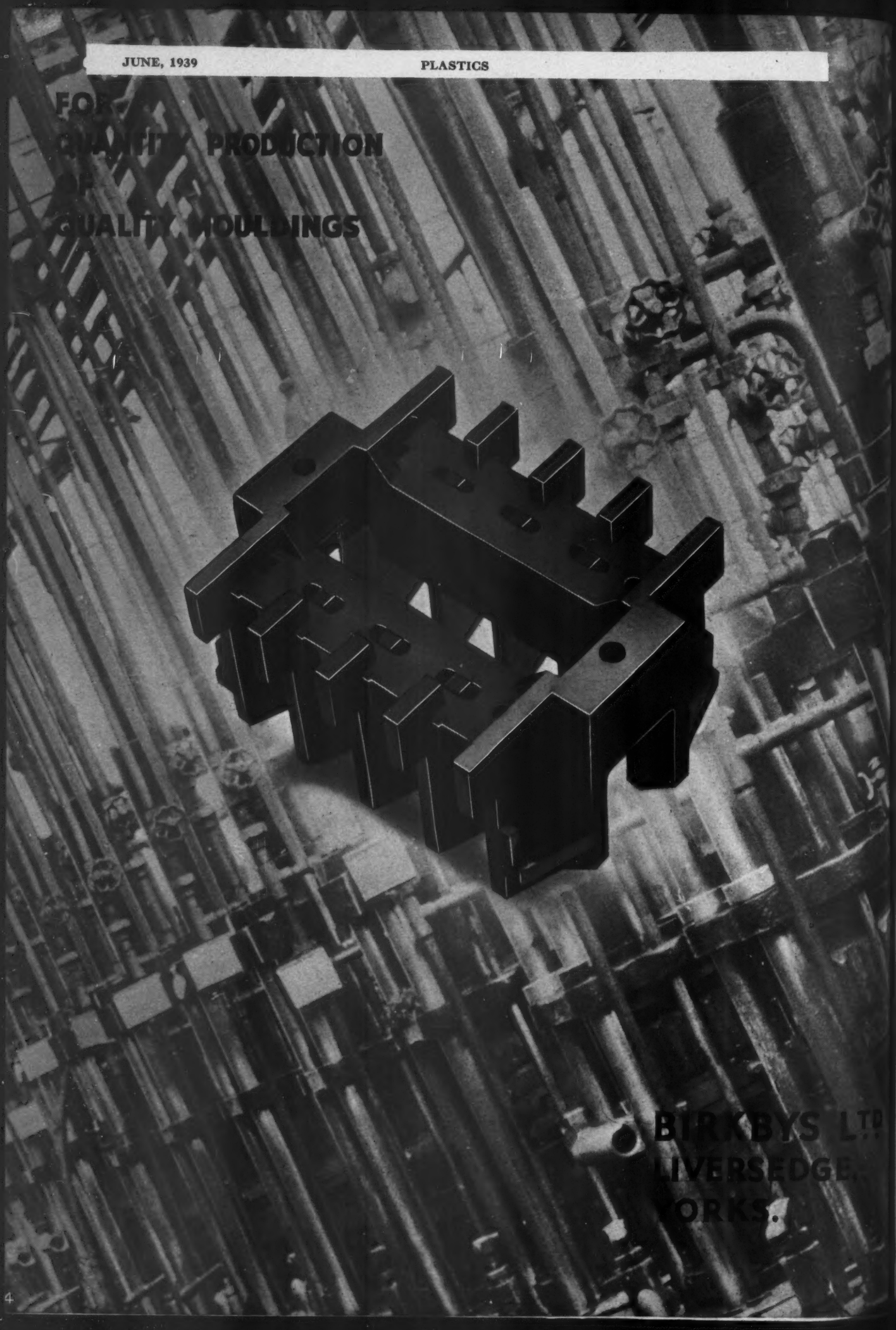
Plastics

DEALING WITH THE MANUFACTURE USES AND POTENTIALITIES OF PLASTIC MATERIALS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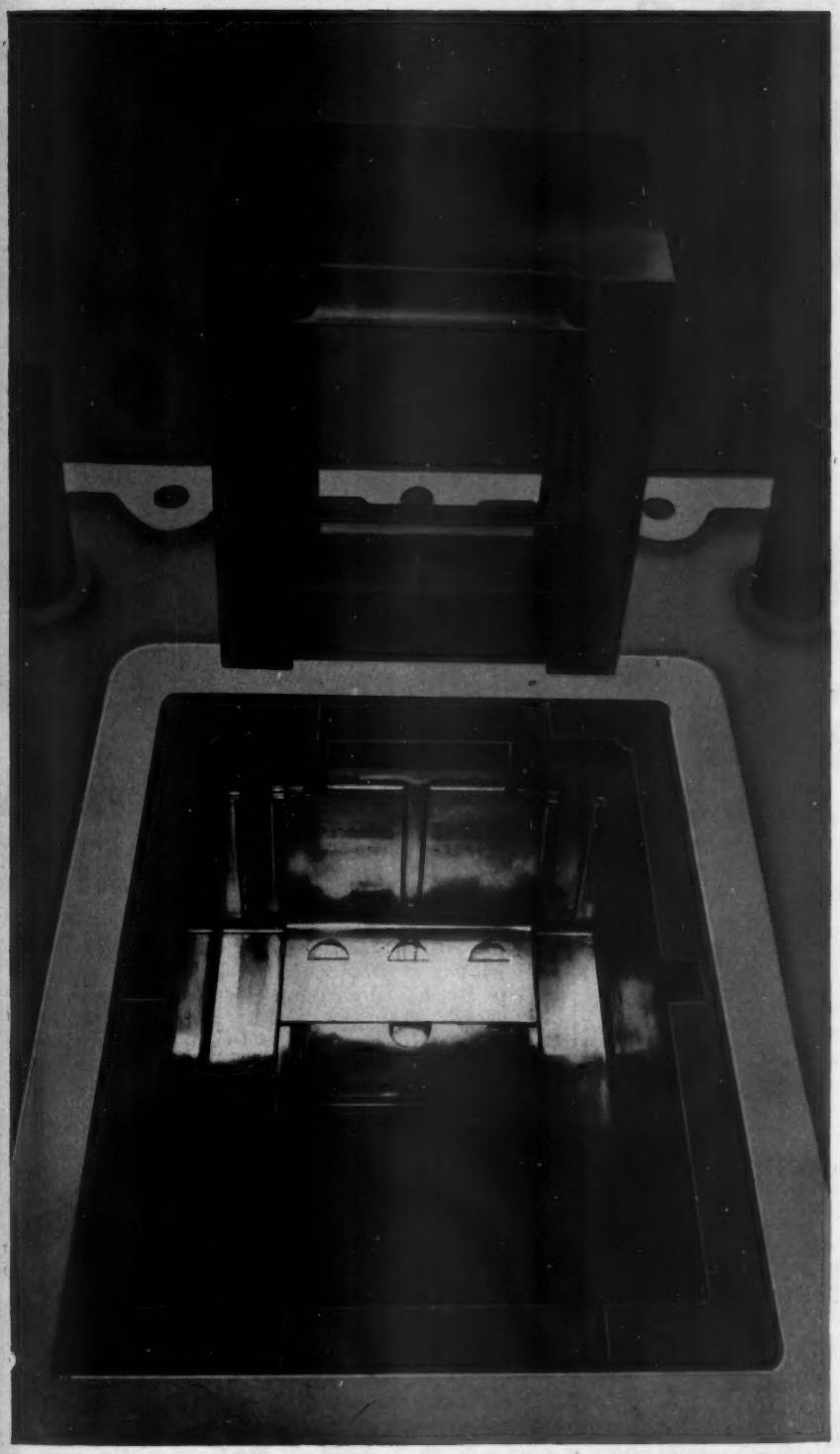
NITRALLOY STEEL

FOR

PLASTIC MOULDING



NITRALLOY MOULD and G.E.C. WIRELESS CABINET. *Photo by courtesy of G.E.C. Witton Moulded Insulation Works, Birmingham.*

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1. Gives the mechanical properties required.
2. Is machinable without difficulty into the most intricate design.
3. Takes the high-class finish which is so essential.
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5. Has a surface hardness after nitriding which is admirably suited to plastic moulds.

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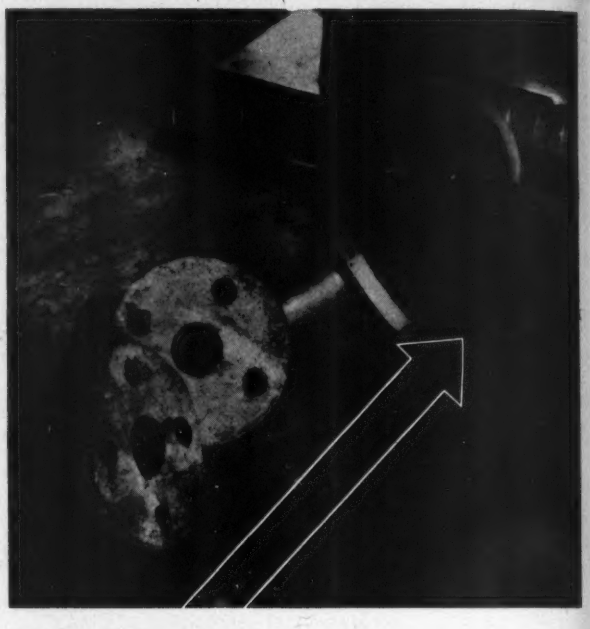

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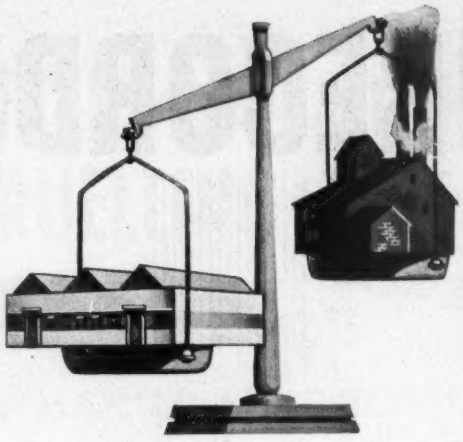

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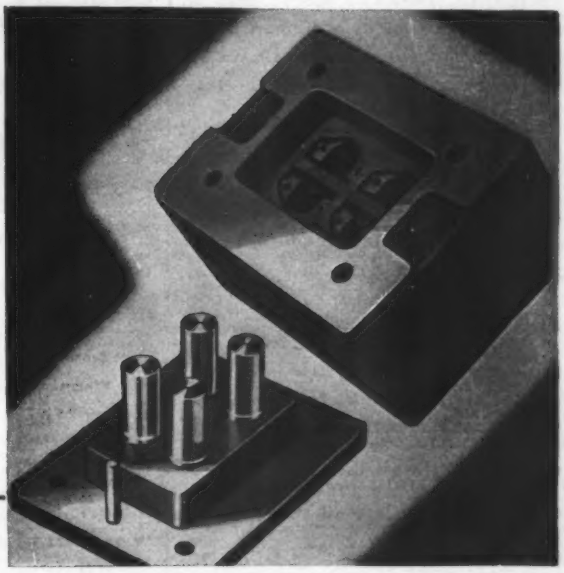

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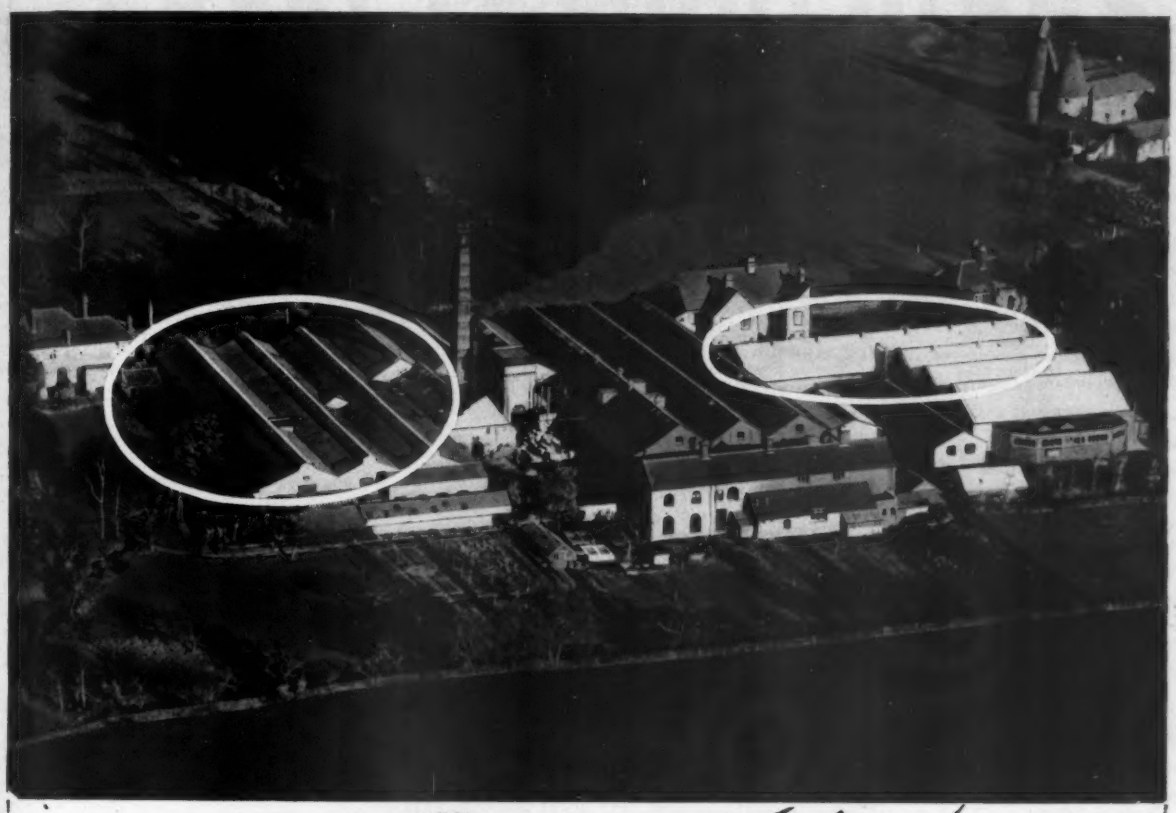

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DIRECTORY OF THE INDUSTRY

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Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials.

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5-17, Rosebery Avenue, London, E.C.1

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Vol. III. No. 25 JUNE, 1939

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Proprietors - - TEMPLE PRESS LIMITED
Managing Director - ROLAND E. DANGERFIELD

Editor - - M. D. CURWEN, B.Sc., A.I.C.
Offices - 5-17, Rosebery Avenue, London, E.C.1

The Largest Moulding Yet

IN normal life the making of a structure larger than it has been done before always provokes considerable interest and some admiration, although often there is little or no difficulty in passing from the smaller stage to the larger.

In the plastics industry large mouldings are more than of passing interest, especially to plastic engineers, since there is considerable difficulty in passing upwards in size. This can be readily realized by the comparative smallness of mouldings in general as compared with those of cast iron. A few years ago the biggest moulding was a radio cabinet, about 2 ft. by 1 ft. by 1 ft., or, perhaps, a circular table top, say, 30 ins. in diameter. The difficulty lies, in the main, in the proper curing of a thick and deep moulding, which obviously needs special methods of heating the powder in the mould. There is also the difficulty in making the steel mould itself, not only from a point of view of size, but also from the point of view of the best method of ejecting the finished moulding. Moreover, there is the difficulty of discovering the best method of filling the die with powder or pellets of the moulding material before pressure is exerted. This difficulty is not negligible. With large mouldings it is far more important to have no rejects than with small mouldings.

This interesting subject is brought up again because we have recently seen photographs of the moulds used in producing what must be the largest mouldings produced so far in this country, viz., moulded coffins. Some months ago we mentioned that a concern in the North had been started for such production. To-day the stage reached is much past the experimental, and the synthetic resin coffin, moulded in one shot, is now a fact. Since the caskets must generally be about 6 ft. long by 2 ft. wide and 18 ins. deep and are moulded from some 90 lb. of moulding powder, there is little doubt that, from the point of size, they are unique.

The producing company, which has promised us further details and photographs in the near future, is the Ultralite Casket Co., of Stalybridge. It is rumoured that it began by considering, merely as a business proposition, what remained possible by moulding technique, the object to have a large and continuous sale, unaffected by fashion or other vagaries, and to be large in size so that competition would not be acute. The originators of the idea must be congratulated. Few of us will quarrel with the suggestion that burial caskets have a large sale, nor within our lives, unfortunately, is the rate of sale likely to drop. It will not be affected much by the vagaries of fashion.

We shall endeavour to follow closely the methods employed, for doubtless we shall learn much which will widen the scope of the raw materials of our industry in channels at present untouched.

The Playing Card of To-morrow

BEING but mild gamblers and devoted only to the excitement of "Snap," we have had little need for regarding the playing card as an object requiring drastic reform. The grubby state of our private packs would invoke, no doubt, the horror of the Portland Club.

However, judging from recent information we have received from the United States of America, manufacturers, technicians and inventors have sought for many years to produce an ideal playing card. Countless materials have been tested for this purpose, including aluminium, celluloid, etc. The requirements for a perfect playing card are unusually exacting. The material must be white, low in price, free from distortion, it must not absorb moisture, it should retain its snap under all atmospheric conditions, it must be easy to print upon and should be non-inflammable. Paper meets most of these conditions, but it is readily marked, cannot be washed, and, in moist, hot climates, perishes rapidly with use. Professional card players have to change the paper pack for each game.

During the past 25 years, various plastic materials have been used for the production of playing cards. It appeared logical that modern synthetic resins properly compounded should solve the problem of washability, snap and wear in playing cards. Cellulose nitrate and acetate are being experimented with. The former is being rejected because of its fire hazards, the latter because it absorbs moisture and loses snap in damp weather.

Dr. Edward F. Higgins, formerly chief in research in Du Ponts, and Dr. Robert W. Carter have made exhaustive researches into modern synthetic resins, seeking a compound that would give a printing sheet with

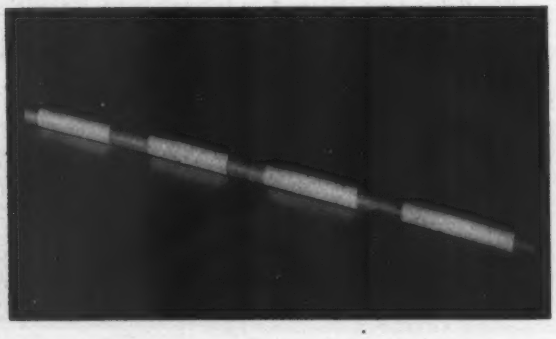
superior resilience, low water absorption and positive non-inflammable qualities. After three and a half years' research, they have applied for patents in the United Kingdom on a material that has met all these qualifications established by over two years' testing. The material comes in sheets 20 ins. by 50 ins., has a beautiful, white surface not unlike china before it is glazed. Experts in the card industry state that they have never examined a material with such remarkable flexing qualities. The printed cards may be washed with soap and water when soiled. The material will not ignite.

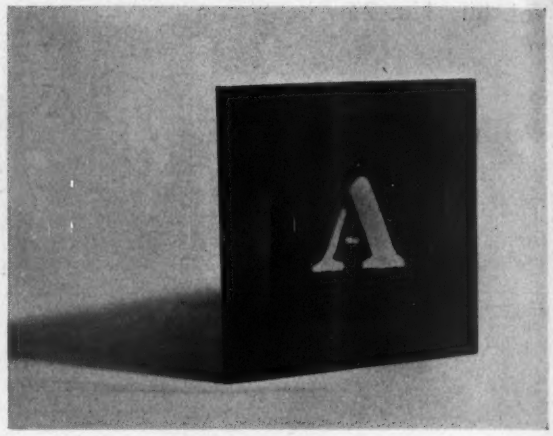
Metal Spraying of Plastics

OUR editorial last month on this subject has created interest in several quarters, and with the object of pursuing the matter further, we have taken steps to get into touch with two concerns whose work should prove helpful to the plastics industry, namely, Metallisation, Ltd., of Dudley, Worcestershire, and Schori Metallising Process, Ltd., of Brent Crescent, London, N.W.10.

The first named, if we remember right, was the first concern in this country to introduce metal spraying on metal. In their process a ribbon of metal is passed through a hot flame produced in a pistol and is atomized and sprayed by means of air pressure on the metal to be covered. The process is especially attractive to the chemical industry, for lead and copper may be sprayed on to the interior of chemical vessels and so save the expense of solid lead or copper apparatus. We are informed by this company that metal spraying is now being carried out on plastics for electrical work when a conducting film is required on a non-conducting base. A good example which they send is that shown in the accompanying photograph. Here four thin films of metal are sprayed on to a resin-impregnated paper tube. Presumably, spraying of such a tube, rather yielding in texture, is comparatively easy to carry out. Spraying of the ordinary hard mouldings of phenol-formaldehyde base is also done for electrical purposes only.

Meanwhile we have visited the works of Schori Metallising Process, Ltd., which are conveniently placed for us, with the object of interesting this concern in the subject. We were delighted to hear that, in addition to spraying almost any common metal on metal, utilising powdered metal instead of ribbon, they have been carrying out many experiments on the spraying of plastics on to metal. Readers may remember our report on the process of spraying shellac in the form of powder, developed by workers at the London Shellac Bureau. This has been successfully carried out at these works. We also expressed the hope that it would be possible to spray phenol-formaldehyde powders. This suggestion has been attempted very successfully, and we were shown some excellent films of Bakelite on metal bases.



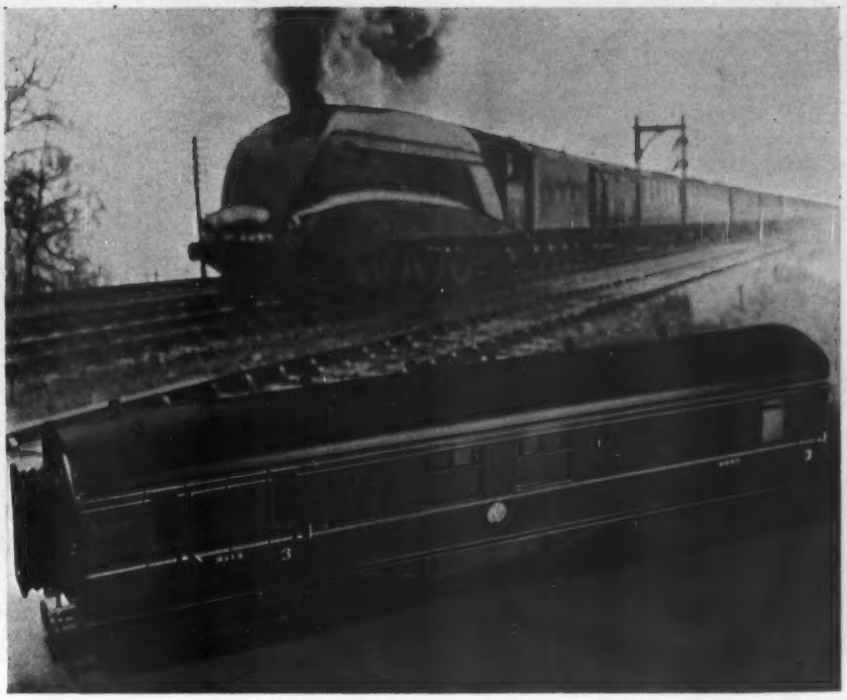


But, to return to metal spraying on plastics. When we visited the works we took with us two examples of plastics—one a moulding of phenol-formaldehyde in the form of a thick plate, and the second a half doll's head made from cellulose acetate sheet.

As they were but first attempts, the results are crude, but they are interesting. The moulding was merely covered with a rough stencil of the letter A and sandblasted; the letter was then sprayed with aluminium. The metal is so firmly keyed to the base that it cannot be removed at all as a film and only as scrapings with a sharp knife.

The cellulose acetate sheet was not sandblasted at all, as it was hoped that the metal would be hot enough to soften the plastic sufficiently and so penetrate it to form a key. This was not the case, however, as the metal spray was comparatively cold at a distance of 5 ins. or 6 ins. from the pistol. Thus the result is not very good, the metal peeling off at certain spots. At others, adhesion was excellent, and the metal film could be polished readily by a wire polishing wheel. It is suggested that much better results could be obtained in a proper cellulose acetate works, where the shaped acetate sheet would be warmed before spraying. It is highly probable that the acetate and metal would be so closely bonded that there would be little probability of separation due to unequal expansions.

Model Rolling Stock of Plastics



The Leeds Model Co., Ltd., are pioneers in the moulding of miniature rolling stock. All drawings are scaled down to 7 mm. to 1 ft.

THE application of plastics to model making is, perhaps, rather obvious because the materials are capable of being moulded to reproduce the most minute detail of the original and combine rigidity with lightness and adequate strength. In spite, however, of the suitability of both thermo-setting and thermo-plastic materials for model making, only a comparatively few firms have so far considered them as really practical and economical alternatives to metal and wood for constructional purposes. One of the pioneers in the model-locomotive field is the Leeds Model Co., Ltd., who for two years have been producing some of the finest examples of coaches, brake vans, trucks, etc., in phenol-formaldehyde and amino-resin moulding powders.

The moulded coach illustrated, which weighs 1 lb. 2 oz., consists of two pieces, the actual body of the coach weighing ¾ lb. and the roof weighing 6 oz., and it is easily the largest complete moulded job ever undertaken by a model maker. The Leeds Model Co. are particularly proud of the fine finish of this coach, and they have good reason to be, as every detail has been considered to make it as realistic as possible. Sliding ventilators on the windows have been added and the windows themselves, which are small panels of cellulose acetate, slide into slots and can be removed and replaced in a second. The roof is moulded separately to enable the user to insert his own interior fittings.

From a production standpoint, plastics have many important advantages. Moulding is a repetition job fairly easy to control and making use of semi-skilled and inexpensive labour. Production figures with single-impression moulds are economical. In the case of the coaches, the actual bodies can be moulded at the rate of 8 per hour and the roofs at 12 per hour; wagons at 16 and boxvans at 12 per hour. When the flash is removed and the rough edges of the moulding smoothed down with a file, very little finishing is necessary, except for a few odd touches of gold or transfers, which juvenile labour can easily carry out. Unlike metal, the moulded coach or wagon does not require expensive painting and comes out of the mould in very nearly a finished condition and with a wealth of detail that would be practically impossible to copy in the case of metal or wood without a great deal of trouble and

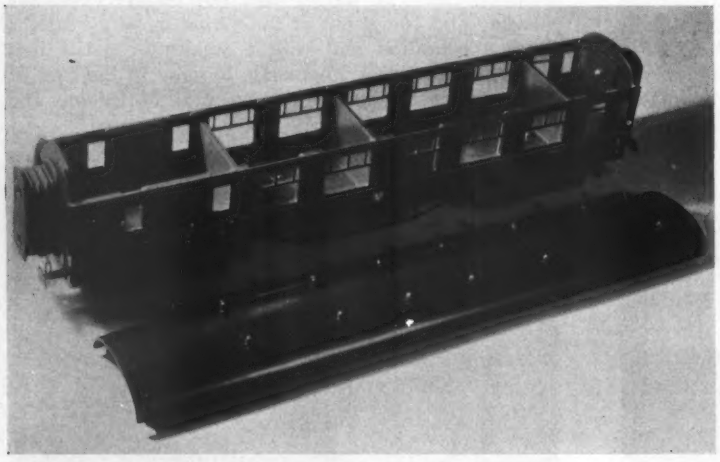
Taking the moulded coach out of the press in the factory of the Leeds Model Company.

Complete in every detail, these moulded trucks look very realistic.

expense. Take, for instance, the wealth of detail in the coach illustrated, or, to give it its full name, the 3rd class vestibule brake composite. This includes handrails, steps, dummy electric fittings, corridor connections, carriage handles, hinges, glazed windows and step-boards. All faithfully reproduced.

From the user's point of view, and the user in this case is the model enthusiast both young and old, the material of which the coaches and other model railway stock are made will easily drill and tap and is of an insulating nature, so that wiring for electric lighting can be accomplished without difficulty. The mouldings are also impervious to climatic conditions and do not warp or buckle in the same way as glued plywood constructions. Then, again, they do not get shabby through loss of paint and maintain their smart colour and finish indefinitely.

It is interesting to note that the experience of the Leeds Model Co. has been so successful, in the case of model rolling stock, that the firm is now planning to produce models for industrial purposes as an aid to sales for manufacturers of plant and machinery. There is undoubtedly a very wide market here, and one which, so far, has been practically untouched.



The complete coach is moulded in two parts of Scarab moulding powder made by British Industrial Plastics, Ltd. The tools for all the models were made by Messrs. Barber and Duffy, of Cardigan Road, Leeds.

Plastics in War

The Comptroller-General's report, which has just been issued, shows that munitions of war inventions increased last year by more than 20 per cent. compared with 1937. A notable feature has been the production of vehicle bodies and aircraft fuselages and girders from synthetic resins.

A good deal of attention has recently been devoted to the possibility of using moulded shell cases and in our issue of August, 1938, we mentioned a patent, B.P. 484,438, which described the production of bombs and shell bodies from laminated material. There is no doubt that the idea is interesting and may, in the future, assume considerable military importance, especially in the case of aerial bombs and torpedoes. One of the most obvious applications of plastics in war would seem to be for moulding hand grenades, and it is rather surprising that the War Office has not tried out the idea on an experimental scale. Laminated material has been suggested, and indeed tried out, for moulding helmets, but the results are not yet available. We do know, however, that laminated plastic helmets are used by miners in America and to a certain extent in this country and apparently give very satisfactory service under difficult and very hazardous conditions.

Synthetic rubber is finding an increasing number of new uses in armaments and one of the latest is in gun carriage mounts and for impregnating the gas envelope fabric used for balloons and airships.

Left:
Tongue depressor fitted with curved rod of Lucite which transmits light from bulb in handle on to oral cavity.

Right:
Illumination of the sinus through Lucite rod and the tissues above the eye. The light is "cold" and of no inconvenience to the patient.

"Piped" Light Through Transparent Plastics

IN certain American applications of plastics, advantage is being taken of the ability of these materials to transmit light around corners and to deliver it either in a concentrated beam or by diffusion through the walls of the plastic rods which are employed. This method of "piping" light to the desired point has certain advantages and accomplishes results not easily duplicated by other means. It depends upon the property of "internal reflection" which is possessed by natural quartz as well as by the acrylic plastics and in at least some degree by other transparent plastics such as the styrenes, although the acrylic plastics, because of their remarkable transparency (said to exceed that of crystal), have an advantage on this score. Light directed against one end of a bar or rod of the transparent plastic is transmitted from end to end thereof, even though the bar be bent or even tied in a knot. Very little of the light leaks through the side walls of the rod unless the latter be broken by grinding or carving.

The methyl methacryliate plastic produced by E. I. Du Pont de Nemours and Co., in America, and also under the name of Perspex by I.C.I., Ltd., in England, is, perhaps, most widely used for "piping" light. In transmitting the light it partly filters out the heat-carrying infra-red rays and, being a poor conductor of heat, does not carry heat from the light source by conduction. Thus, the light is "cold," and if the source of light be "white," a bright white light is transmitted. An important consideration is that the plastic is not fragile like glass and is thus suitable for many uses where glass would be too easily broken and become a physical danger as well as an economic loss.

Among the recent applications in which Lucite is being used for "piping" light are several dental and surgical instruments, some of which are here illustrated. This form of illumination makes available to the user of such instruments a powerful sterile beam of light without heat, glare or danger from electric shock. The instruments include cheek and other retractors, a tongue depressor and a laryngeal probe as well as devices having rods of Lucite for transmitting light without performing other functions. A small bulb operating off a six-volt circuit or from a dry cell at still lower voltage is the usual light source and in some cases is fitted into a handle which may also include the dry cell if this be more convenient than a flexible wire cord. So called "transilluminators" designed to transmit light through body tissues are among the instruments used, as in illuminating sinuses, for example. As Lucite softens if heated in boiling water, instruments made from it are kept sterile by dipping in a cold solution containing one drop of methalene blue (1 per cent. aqueous solution) to 4 oz. of 70 per cent. alcohol.

Some of the instruments were shown for the first time recently before the American College of Surgeons in New York and later before the Interstate Post Graduate Medical Convention in Philadelphia, among other medical and dental organizations. They are reported to have attracted widespread comment. Instruments here illustrated are products of the Curvlite Sales Co., 567, Third Avenue, New York.

One of the earliest commercial uses of Lucite rod for light transmission was in batons for orchestra leaders, especially those in cinema theatres where it is necessary to see the baton in the dark. The base of the baton contains a dry cell and bulb, the latter being turned on when required. Light issues chiefly at the tip of the

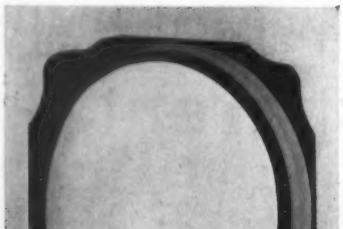
rod and is easily seen by members of the orchestra but does not produce glare in the eyes of the audience.

Another use of "piped" light is found in aircraft instruments manufactured by the Pioneer Instrument Co., Brooklyn, N.Y. These instruments employ a minute light source about the size of a grain of wheat, the tiny bulb being set between the ends of a split ring moulded either in acrylic or styrene plastic. The ring is mounted between the instrument dial and the laminated cover glass and against a concentric continuous bevel-edged ring of the same material, which ring bears front and back against "Corprene" gaskets to make a tight joint. In this application, the light passes around the split ring in both directions and is diffused through the side walls in such a way as to illuminate the instrument dial, which the rings encircle without causing glare. Portions of the two rings are painted in such a way as to reflect and diffuse the light and distribute it uniformly around the entire periphery of the dial. The light source itself is completely hidden, as the bulb base screws into a recess in the die-cast front frame of the instrument. This arrangement makes an extremely light and effective assembly, adding practically nothing to the weight of the instruments.

Plates of cast plastic of the type mentioned can have lettering engraved or otherwise cut in the surface and the lettering stands out brilliantly (with the remainder of the plate almost invisible) when the plate is set into a slot in a base or holder with a concealed light source.

Still another use for Lucite rods has been found in automatic phonograph cabinets, the rods being disposed across the face of the cabinet with ends turned inward over concealed lights of different colours. The result is a brilliant play of lighting intended to attract attention to the phonograph, which is of the coin-operated type and is installed in taverns, dance halls and the like where there is a demand for music. This is largely a decorative and attention catching application, but has accounted for the use of much plastic in a way which is profitable to those who rent the phonographs and count upon getting them to be used by customers willing to pay for musical entertainment.

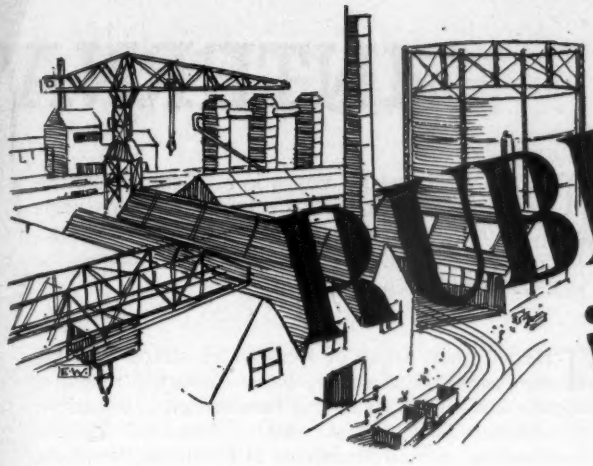
Another important use for transparent light-transmitting plastics is in display fixtures for store windows and exhibit booths at expositions. To date, full use of the modern means of "piping" light has not been taken in such products, but it requires little imagination to see how it can be employed with telling effect. Several display fixtures at the recent annual automobile show in New York made excellent use of transparent plastics and there is little doubt that they will see much wider use for similar purposes.



(Below) This cheek retractor is one of several instruments manufactured by Curvlite Sales Company, New York, for dental and surgical use. The whole lower portion of the instrument is a formed (curved) piece of transparent Lucite through which the light passes from end to end, issuing in such a way as to light surfaces which the dentist must see clearly.

(Below) "Piped" illumination, free from heat and glare, is effected by this curved Lucite rod, one end of which is illuminated by a bulb in the lamp housing in the background. Light issues at the opposite end and is directed where required. This is one of several experimental units designed by the Curvlite Sales Company, for demonstration.

(Above) Back view of aircraft instrument-holder showing white recess for transparent plastic rings which convey light from small bulb in lower right corner.



RUBBER in industry

★

The "Exchange Telegraph" reports from Berlin that Buna is now being made on a more extensive scale at the Schkopau works of the I. G. Farben-industrie A.G. The production figures are not given, but the works employ over 4,000 persons, and it is stated that within two years it will be possible to cover a good proportion of Germany's 100,000 tons annual consumption.

★

Monsanto Chemicals, Ltd., Victoria Station House, Victoria Street, London, S.W.1, remind us that they represent Thiokol, Ltd., both in the United Kingdom and very largely on the Continent. They are also in the position to supply technical information on the various Thiokol products and to advise manufacturers as to the advantages of this well-known synthetic rubber, which is to-day finding so many varied uses in modern industry. Readers wishing to receive copies of *Thiokol Facts*, the news bulletin of the Thiokol Corp., should get in touch with Monsanto Chemicals, Ltd.

★

According to *The Chemical Trade Journal and Chemical Engineer*, May 5, 1939, a modified form of microporous rubber, sufficiently flexible to be folded on itself without breaking, and which is offered for use as a filter medium, has been introduced in the U.S.A. The product is made in two forms, the one of interest to the chemical industries being an ebonite permeated by continuous interconnecting pores of microscopic and sub-microscopic size. It has a porosity of 65-75 per cent. and an average pore diameter of 2 to 4 microns. For filtration work under pressure, the material is made with reinforced construction. It was originally developed as a separator for storage batteries.

★

A new company, Industrial Insulations, Ltd., has been formed in Letchworth to manufacture an improved insulating tape. The surface of the tape is of rubber and is adhesive on both sides. Official tests show that it is capable of withstanding 2,500 volts. The technical director is Dr. Kaupe, who at one time manufactured a similar insulating tape in Vienna.

★

Pliofilm, made by the Goodyear Tyre and Rubber Co. (Gt. Britain), Ltd., Wolverhampton, is now finding many new applications for waterproof garments, and Messrs. Richards, Boggs and King, of 1 and 2, Berners Street, London, W.1, who have the sole manufacturing rights in this country for these garments, assure us that they are rapidly increasing in popularity. Their present range includes a large selection of rain capes, hoods, aprons, shoe bags, etc. The great advantage of Pliofilm is that it is fully transparent, so that it shows up the colours and patterns of the dress, coat or costume worn underneath, and yet affords maximum protection. Six colours are available, red, green, blue, lemon, burgundy and clear, and all colours give fully transparent effects. The material is very light in weight. A rain cape weighs less than 4 oz. and can be carried in a lady's handbag, and even the voluminous garment known as the City Slicker folds up into a remarkably small compass and it may be slipped into an average-size vanity bag with comparative ease. Pliofilm is a rubber-hydrochloride and is softer and stronger than cellulose sheeting. It will not tear easily, is inherently waterproof and may be soaked in water indefinitely without losing that quality.

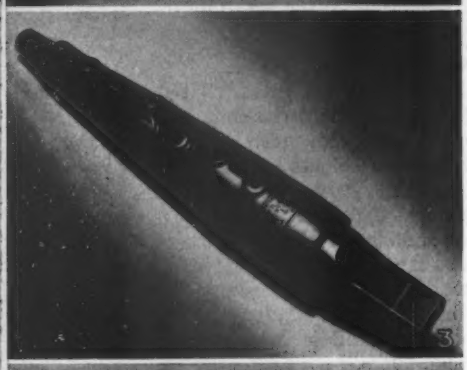
These two examples of new Pliofilm garments are typical of the range now being produced in this country.

D

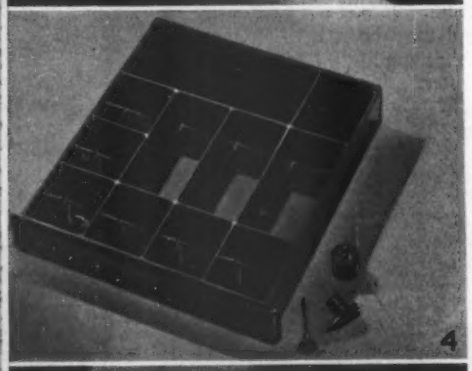
INTERNATIONAL

1 THESE small powder scoops in cellulose acetate are now very popular with the ladies for filling compacts from normal supplies of powder, cream, etc. They are moulded by the injection process by Crystalate, Ltd., for A.R., Ltd.

2 THESE smart Duke of Kent watch straps, now all the vogue in America, have Lumarith moulded buckles and slides, which can be obtained in a variety of colours. They are moulded by Universal Plastics Corporation, of New Brunswick, N.J., for the American Watch Strap Co. of N.Y. Lumarith is a product of Celluloid Corporation, U.S.A.



3 AN increasing number of musical instruments are now being moulded and the example illustrated is typical of several others now being sold in this country. It is moulded of Tenite, the cellulose-acetate material made in America by the Eastman Kodak Co. The instrument is sold in England under the registered trade mark Tonette.



4 CASH drawers moulded of Durite, made by Durite Plastics, Inc., U.S.A., are now being used in some of the latest cash registers in America. The example shown is a particularly fine piece of work.

5 BINOCULAR frames moulded of Bakelite are now used by the celebrated firm of Bausch and Lomb Optical Co. The examples illustrated were moulded by the Auburn Button Works, Auburn, N.Y., U.S.A.

6 THIS watch case, moulded for Dennison Mfg. Co. for use by jewellers in making more attractive showcase and window display, was moulded and designed by the Auburn Button Works, Auburn, N.Y., U.S.A. Moulding material is ivory amino resin powder supplied by both Plaskon and Beetleware Co.

7 THIS nest of horns, made specially for picnic use, is made by Brookes and Adams, Ltd., 250-2, Barr Street, Hockley, Birmingham, 19, and marketed under their trade name Bandalasta. The brown moulded case is made of Banda-wood. Brexton, Ltd., Birmingham, are the stockists.

8 STREAMLINED for service, this signal case is rightly considered a first-class moulding. It measures 3 ins. by 7 ins. by ½ in., and is moulded by the Gorham Co., Plastics Division, Rhode Island, U.S.A.

TIAL RELEASE

16 PICNIC time has come round again, and these moulded aids to happy picnicking should certainly prove best sellers. The articles illustrated are known collectively as the "SPO" picnic unit, which is a very popular line in the Sirram range made by Marris, Ltd., Birmingham.

15 THESE examples of moulded light fittings represent a type now becoming very popular. N.B. Mouldings, Ltd., Tremlett Grove Works, Highgate, London, N.19, are responsible for the work, and they point out the wall bracket shown on the extreme left was moulded in one piece. The moulded strip light fitting is provided with a mirror, which greatly improves the total reflection of light.

14 THIS attractive little novelty is moulded of cellulose acetate by Fraser and Glass, Ltd., Woodside Lane, North Finchley, London, N.12, and is the kind of thing now in good demand for display purposes.

13 CRYSTALATE, LTD., Moorgate Hall, 153, Moorgate, London, E.C.2, have sent us this memo. blotter container moulded of Bakelite, which they are manufacturing for Messrs. Sculthorp Sawyer, Ltd.

12 OUR friends the General Electric Co. of America have sent us this picture of clubs made for A. G. Spalding Co., Chicopee, U.S.A. Their interest to us relies in the use of injection moulded ferrules made by G.E.C.

11 WELL-FINISHED and sensibly designed, these utility boxes moulded of cellulose acetate are very popular in the United States. Universal Plastics Corporation, 235, Jersey Avenue, New Brunswick, N.J., U.S.A., are the manufacturers.

10 INGENIOUS working of a rod of Perspex by Miss Ferelyth Howard, Central School of Arts and Crafts, produced these modernistic carvings representing a unicorn's head. Perspex can be turned, carved, engraved or shaped and retains its brilliant transparency.

9 FROM Canada comes this selection of transparent packages made of acetate sheet material by the Granby Manufacturing Co., Ltd., Granby, Quebec. These boxes are made from lightweight material (7/1,000 and 10/1,000).

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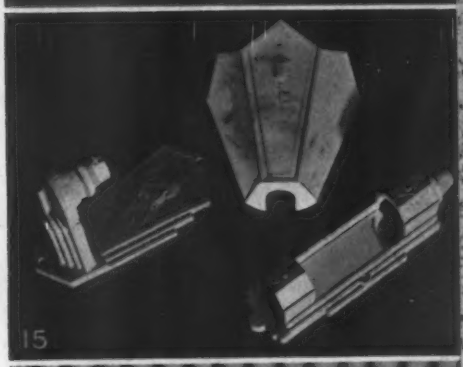
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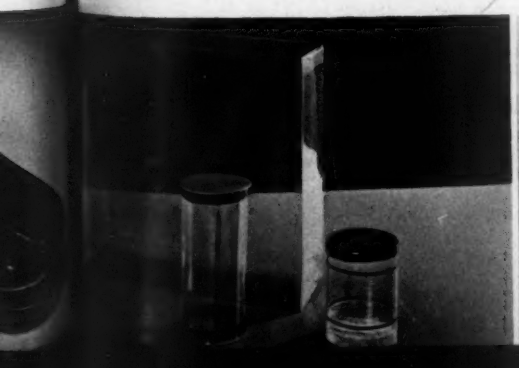

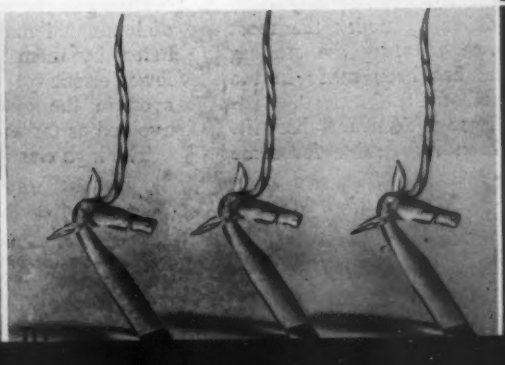

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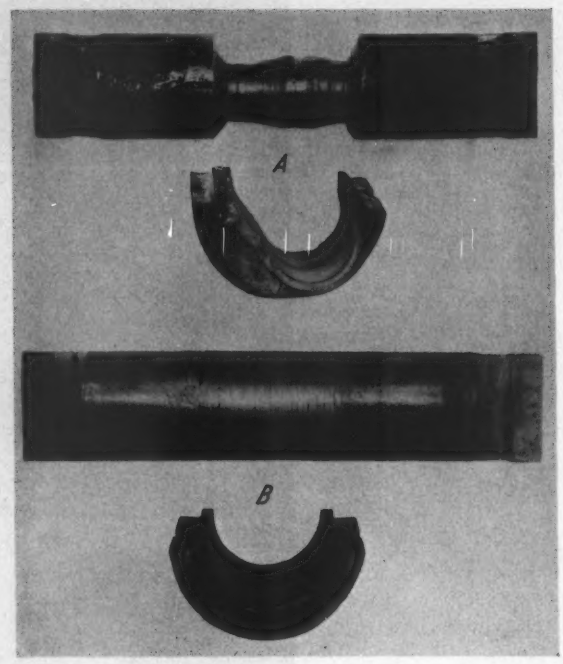
PLASTIC ROLLE

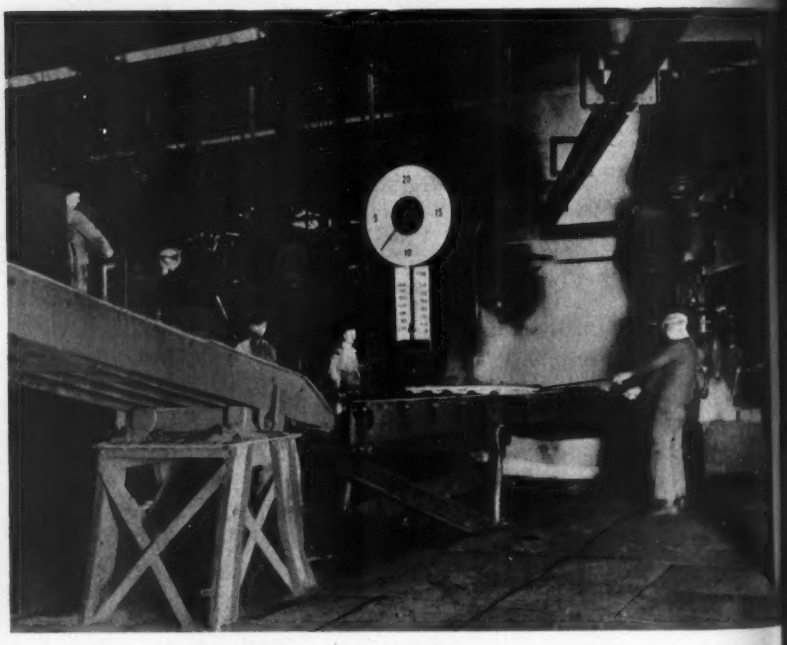


Steel neck and bearing of a cement transporting worm after 500 running hours. The raw powder transported has a temperature of 140 deg. C. As is known, it is impossible to lubricate this bearing. A = steel neck and cast-iron bearing brass. B = steel neck and bearing shell of synthetic resin.

of the most outstanding developments in this highly specialized field.

Before discussing the important advantages which can be claimed for plastic bearings, it is, perhaps, as well to give a brief account of their manufacture and peculiar structure. Most of the laminated bearings are made by impregnating canvas, linen or paper with phenol-formaldehyde resin (sometimes cresylic resins) and then compressing a large number of layers under hydraulic pressure in heated steel moulds to the shape required, or to obtain a block which is subsequently machined to form. The chemical change in the resin during heating converts the laminated plastic mass into an infusible, tough and hard-wearing composite material, which is really a type of brake lining.

Bearings made of cellulose fibres impregnated with a properly cured hard resin differ considerably from those of the conventional bearing materials. Synthetic resin damps vibrations, and bearings made of this material enable the rolls to run smoothly. Another very important factor is that, despite the high elasticity and



820 mm. three-high sheet mill.

AS long ago as 1928 plastic laminated bearing materials were used in Germany in place of the usual base metals to equip a well-known rolling mill. The results of this first experiment were so encouraging that engineers all over the world, particularly in Germany, where there was a shortage of metal, were stimulated to give very serious consideration to the claims of the new materials and to evolve ways and means of improving their efficiency under the most strenuous conditions of service. During the ensuing 10 years very great progress has been made in the manufacture, design and methods of lubricating the laminated bearings and Demag Aktiengesellschaft, Duisburg, Germany, have been responsible for some

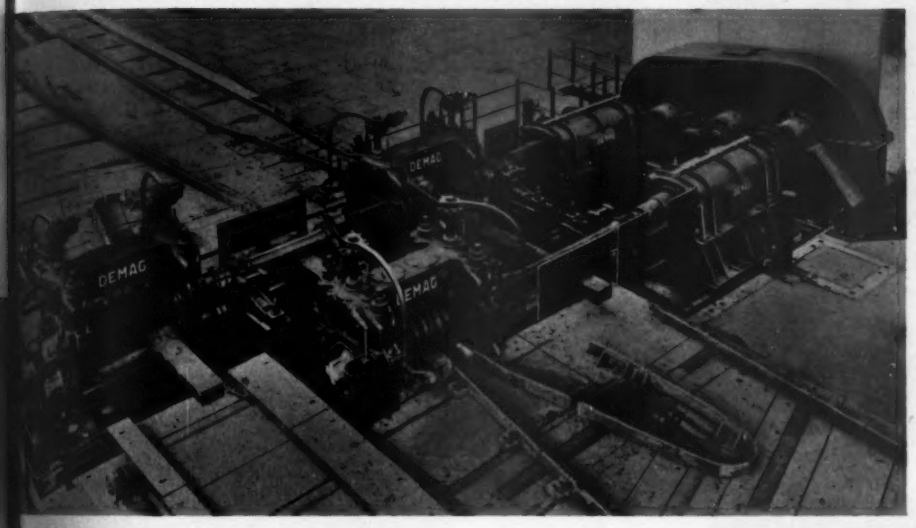
a certain amount of plasticity, bearing materials of synthetic resin offer great resistance to wear and have a polishing effect on the neck material. The efficiency of the bearings is thus much better after being run in. When, however, the neck material is too soft (hardness less than 200 Brinell), the neck will begin to wear if the bearings are highly stressed.

Owing to the much higher elasticity of bearings made of laminated material, end pressures can be absorbed better by them than by the usual metal bearings of lower elasticity. End pressures, however, are harmful even in the case of synthetic resin, and should be avoided as far as possible.

The high elasticity, in combination with low plasticity

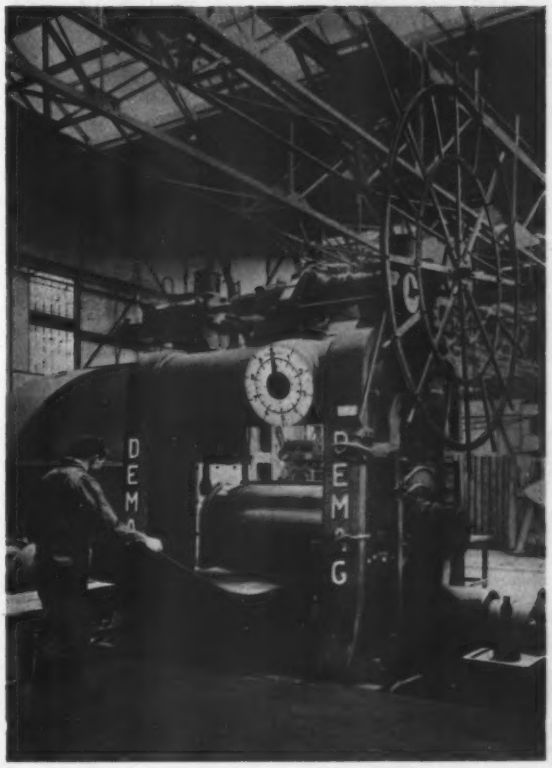
NECK BEARINGS in the German Steel Industry

Demag Aktiengesellschaft, Duisburg, have equipped a large number of steel rolling mills in Germany and their experience of plastic bearings is unique. This article is a precis of a recent treatise on this highly important subject published by the company



550 mm. cross-country mill equipped with bearings of synthetic resin plastic.

650 mm. two-high finishing mill for light metal sheets, fitted with bearings of synthetic resin plastic.



of the synthetic bearing, makes it easier for particles of dirt and dust to become embedded in the material. This can be turned to good advantage where the bearings have to be used in dusty works, such as cement mills, where they are often badly lubricated and otherwise neglected.

The most important factor influencing manufacturers in favour of laminated bearings is their reduction of the power necessary to drive the mill. Demag have found, as the result of their own experience, that, by changing the bearings of existing rolling mills from metal to plastics, the load on the rolling mill engines is reduced by about 10-40 per cent. and an increase of power is enjoyed by the mill itself.

The life of the synthetic resin bearing depends, to a large extent, on the quality of the lubricant used. Although in some cases it is possible to dispense altogether with grease, this is by no means a general rule. The roll-neck bearings frequently work in the state of semi-fluid friction. If suitable special greases of high viscosity, corresponding to the pressure to be absorbed and of slight inherent friction are employed, fluid friction will be obtained in the bearing in many cases if it is designed correctly and in the form that will favour the formation of the film of lubricant. This will result in slight heat development in the bearing, small loss of power and long life. In many cases, especially in slightly loaded bearings with neck velocities over 1 metre per sec., it will suffice if the roll necks and radial shells are greased when the

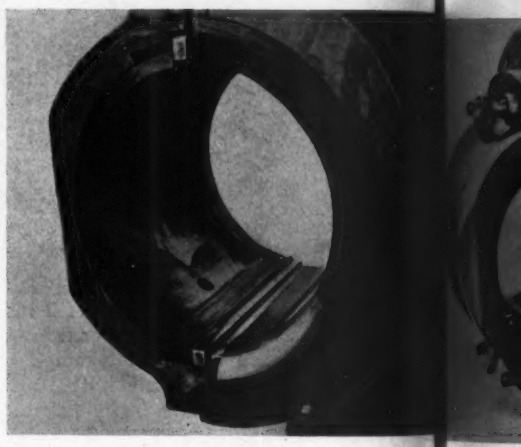
roll is put in and they are lubricated and cooled later with water. The sprays must then be arranged in such a way that the water will be compelled to enter the gap between the radial shell and the neck.

Direct cooling with water is recommended wherever practical, so as to dissipate heat as rapidly and uniformly as possible. Water boxes are recommended for real intensive cooling. Although it is expensive to use pressure oil for lubricating and cooling, it does give good results. In such a case it is advisable to provide cooling grooves in the shells and the quantity of lubricant must be large enough to make sure of the heat in the bearing being carried off. The use of emulsions as lubricants appears to be advantageous, provided, of course, that the emulsion is not basic and has no great swelling action on the surface of the bearing. In the case of reversing mills, it is advisable to employ lubricating shoes to distribute the grease, fed under pressure, uniformly over the neck. The construction of the bearing is then the same as when employing grease bricks.

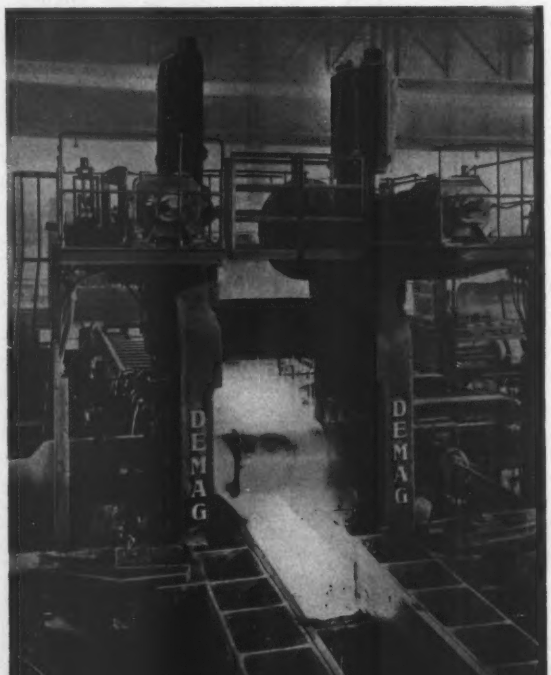
The most economical form of roll-neck bearings of synthetic resin plastics is one with an angle of enclosure of 120 degrees, when a narrow, wedge-shaped chamfer must be provided at the side of the radial shell, forming a gap between the shell and the neck, to allow the lubricant to be pulled in. If the specific load on the surface is a low one, the angle of enclosure can, of course, be kept smaller and, if need be, also enlarged to 130 degrees. Experience has shown that angles of enclosure larger than 130 degrees are inadmissible, as such bearings, under the influence of the load, friction and heat, are liable to grip the neck. This, of course, leads to the development of heat, increased friction, prevention of satisfactory lubricant film and, finally, premature destruction. In the majority of cases the inner surface of the bearing that is not quite a half-circle is found to be the most favourable one in respect of power consumption, length of life and economic efficiency.

Owing to the low bending strength of the bearing material of synthetic resin, it is necessary for the radial shell to lie snugly in the chock. The high elasticity and the low notch impact value of the material call for thin, but uniform walls, and large fillets. In a bearing, in which the thickness of the wall at the centre of the shell varies a lot, the parts where the walls are thinnest, in keeping with the total elasticity of the bearing, must withstand much higher surface pressures than parts at which the walls are thicker, when weaker forces suffice to bring about elastic deformation in keeping with the sum of elasticity in the bearing. The most uniform wall thickness is obtained by limiting the outer surface of the bearing to that of the inner surface, that is, a half circle. This shape is also very suitable for accurate fabrication. As more exact sits are obtained by turning and boring than by planing and slotting, the cylindrical outer surface is also the most favourable limitation of the bearings of laminated material.

In the case of small mills that are not heavily loaded, the bearings are moulded in one piece. Large bearings are no longer made in this way, however, as the costs for the mould are too high. Such bearings are made up of moulded segments, keeping the shell separate from the thrust collar. This is very advantageous as the integral parts possess different lengths of life.



Looking on to the cooling chamber of the bearing cap. Synthetic resin bearing made of segments.



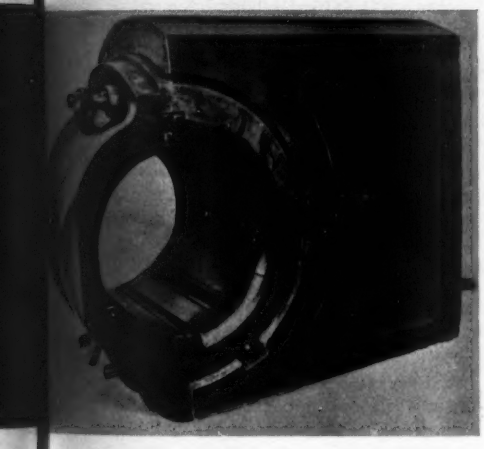
950 mm. two-high blooming mill.

The length of the bearing surface is very important and greatly influences the life of the bearing. Experience has shown that the surface should be just long enough to allow a carrying film of lubricant to form. In deciding the thickness of the radial shell several important factors have to be taken into consideration. First of all the bearing must be sufficiently thick to ensure a reasonably long life. At the same time, in order to roll metal economically to gauge with small tolerances, it is necessary to have comparatively thin shells so as to minimize the influence of the elastic deformation when the magnitude of the roll pressure undergoes a change. This minimum thickness is also essential for machining and for the clamping of the bearings in the chock. In the case of highly stressed chocks a thin wall thickness of the bearings makes it possible to enlarge the highly stressed cross-section of

the chock, with the result that there is greater reliability and less deflection. Another important argument in favour of thin walls is that there is the minimum waste of material as, unlike worn metal bearings, they cannot be melted down and recast for future cast.

The most economical thickness of radial shells, in the case of small bearings, is 10-15 per cent. of the diameter of the neck and, in the case of bearings of medium size, 7.5-10 per cent. and, for large bearings, about 5 per cent. and less. If heavy wear of the bearing is to be taken into consideration, preference should be given to somewhat thicker walls.

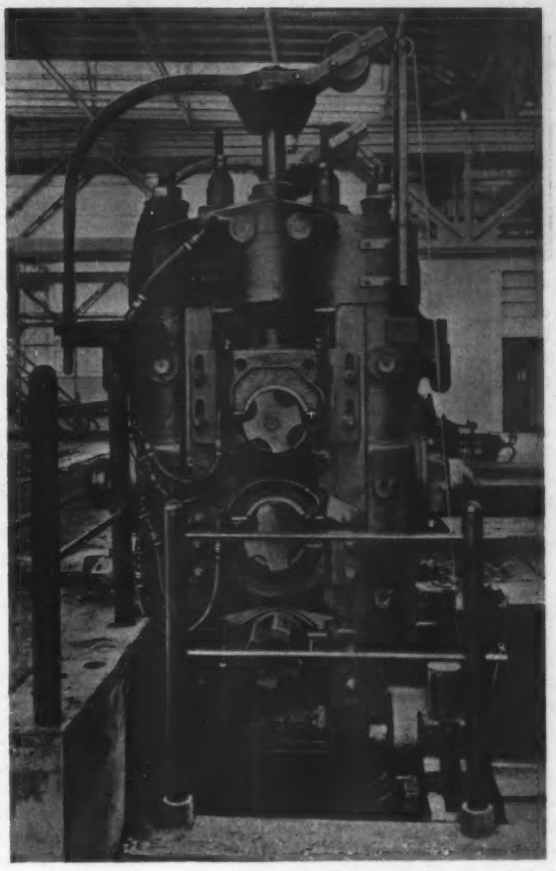
Owing to their poor thermal conductivity, bearings of laminated material require more play between the bearing surfaces of the shells and necks than bearings of base metals. In consequence of the heat expansion the diameter of the neck will be greater at the working temperature than at room temperature; the same applies to the thickness of the shell. For a bearing with a diameter of 500 mm., a radial shell thickness of 25 mm. at a working temperature of 50 degrees C. and an angle of enclosure of the carrying surface of the bearing of 120 degrees, with grease lubrication and direct water cooling, it is necessary for the bore of the bearing to be 1.5 to 1.8 mm. larger than the diameter of the neck, in order that the bearing may run perfectly. For large



Chock with synthetic resin bearing of a rolling mill with 380 mm. neck. View looking on bottom shell.

and medium size bearings good results have been obtained with the bearing play at 3/1,000th of the diameter of the neck, thus the bore of the bearing amounts to 1.003 by diameter of the neck. The larger the angle of the actual carrying area of the bearing the greater will be, under conditions otherwise similar, the loss of power and consequently the heat that develops through friction in the bearing. This angle must, therefore, not be too large, about 90-100 degrees.

Bearings of laminated material are suitable for hot rolling mills and cold rolling mills, but the special problems of each have to be very carefully studied so as to develop the most efficient type of bearing. In the case of hot rolling mills producing small sections, wire rods and narrow strips of mild steel, the change from metal to plastic bearings can be carried through without any difficulty. The roll necks are greased when put in and then lubricated and cooled with water alone. Mills for producing light semis, sections, rods and medium sections may use plastic bearings lubricated in the same way. The most efficient form of bearing for these mills is one with cross-section in the form of a



550 mm. three-high stand. Chocks equipped with moulded half-round shells of synthetic resin plastic.

crescent. In the case of collar thrust bearings for the vertical rolls of the merchant mills, regard has to be paid to the radiant heat and protection afforded against the action of the roll scale. For these bearings it is difficult to change from metal to laminated material. Demag state that in the universal stand only the horizontal rolls are mounted in synthetic resin bearings. In all other types of hot roller mills where excessive heat is present the replacement of metal for plastic bearings is always difficult, but in a large proportion of cases may be achieved if the bearing is designed specially for the job and the necks are smooth and free from fire cracks. The change over to synthetic resin bearings will be a success if the bearings are designed with the utmost care by an experienced man and if some of the important points, such as bearing play, lubricating chamfer, cooling and protection against scale, are checked and supervised by men actually working the plant.

Cold rolling mills for producing cold rolled sheets and strips of steel or non-ferrous metals, etc., make use of much heavier pressures than is customary in the case of hot mills. The greatest precautions have, therefore, to be taken in cooling the bearings and compensating for the effects of serious deflection of the rolls. The general experience in Germany is that, provided suitable alterations are made in the design, position, etc., of the bearings, chocks, roll necks and also the cooling and lubrication, most cold rolling mills can advantageously switch over from metal to plastic bearings.

WORLD'S INDUSTRY

TEXTILES

Casein fibre was subject matter of paper read at Constitutional Club, Manchester, by H. A. Thomas, Ph.D. Casein fibre possesses merits which render it suitable for admixture to produce novel effects. Mixture with wool especially suitable as both are proteins. Advantages over wool: (1) Casein fibres more uniform. (2) Show no tip and root effect. (3) More uniform contour and are more lustrous. (4) Require no scouring or carbonizing. (5) Spinning of finer yarn facilitated by blending with wool. Casein fibre does not impair felting of wool and is consequently of value in the hat trade. Special methods of dyeing and the precautions to be taken while dyeing were described. **Pickers,** buffers, straps and various other parts of the picking mechanism are now being made of rubber, states a writer in *Yorkshire Observer*, May 11, 1939. Among the new rubberpickers are types furnished with self-lubricating resinous bearings round the spindle rod, and other new features include different consistencies of rubber, softer and more resilient at parts of the pickers where shock absorption is particularly needed. Synthetic rubber now successfully used as a bearing material. For instance, in rubber bushes, shackles, packing rings, belting, etc., many persons have experienced no small difficulty in the matter of correct lubrication. It is found that ordinary lubricating oil is unsatisfactory owing to its probable chemical action on the rubber. The use of water, while not harmful, is yet far from satisfactory, owing to the rapidity of its evaporation, excepting in specially favourable circumstances. Colloidal graphite is now being tried with very great success, so much so that a patented lubricant has been developed containing this substance in conjunction with glycerine and water. The glycerine and water, themselves lubricants, also act as carriers for the microscopic particles of graphite, the latter forming a slippery surface on the rubber, which is understood to provide not only a highly efficient, but also lasting, lubrication. It is stated, moreover, that the use of this lubricant serves to protect the rubber from oxidation and from wear, thus maintaining it in good condition. **Nylon** developments in this country arousing considerable interest according to *Manchester Guardian*, May 12, 1939. There is as yet no indication that the new company formed by I.C.I. and Courtaulds, Ltd., for the joint manufacture in Great Britain of E. I. du Pont de Nemours's product, would compete in the bristle market. The paper does, however, point out that in the event of the new concern manufacturing "Exton" bristle, natural fibre suppliers may be faced with severe competition for the filament has claimed for it general properties equal to those of natural fibre, whilst its durability is said to be superior. No details of price are yet available, but as "Exton" bristle is produced from an easily workable plastic batch-like dough by a simple extrusion process, manufacture may be achieved at a price level which will enable "Exton" to compete on very favourable terms with natural bristle. The new nylon plant in the United States, which has been laid down at Seaton, Delaware, is, however, not expected to reach a production stage until 1940, so that—assuming a similar time lag in this country—the brush interests, who generally hold large bristle stocks, will have ample time in which to make any necessary adjustments. **Elastic sewing thread,** sold under the trade name of "Ruvis," is made from an elastic thread which is a combination of viscose and latex rubber. In sewing-thread form it is said to be making rapid strides for shirring for both factory and domestic use. Shirring seems to be most popular at present for all types of garments as a result of the introduction of sewing machines.

GENERAL ENGINEERING

Leather industry in Germany said to be now using phenol formaldehyde and vinyl resins for tannery equipment. F. Stather and H. Herfeld (*Collegium*, 1938, 578-590) survey the substitutes for copper and brass in tanneries. Authors state that iron, zinc, magnesium and magnesium alloys are not satisfactory. The corrosion-resistance of monel metal is high and chromium nickel and chromium, nickel molybdenum steels are more resistant than copper, but are very expensive. Pure aluminium and copper-free aluminium alloys are used in the leather-goods trade and withstand contact with vegetable tan liquors containing small amounts of acid. Referring to phenol formaldehyde and vinyl resins, the writers state that the phenolic resins are attacked by acids slightly more than copper, and the vinyl resins are usable only at temperatures below 50 degrees Centigrade. Lining of vessels with acid-resistant stone, chlorinated rubber and bitumen preparations are also described. **Models of plastics** for specialized engineering jobs described in bulletins of the Engineering Experiment Station, University of Illinois, No. 307. These contain the results of an investigation of rigid frame bridges and tests of reinforced concrete knee frames and Bakelite models. **Cutting fluids** of the soluble oil type have a marked corrosive action on the exposed part of metal lathes. Cast-iron lathe bed metal is particularly open to attack. In Germany, successful attempts have been made to protect exposed metal surfaces with Buna and the vinyl chlorides which are unaffected by grease, neat cutting oils and the various soluble oil emulsions. The latter frequently consists of a mineral oil, such as a pale spindle or machinery oil, along with a fatty oil which has been partly saponified with caustic soda to form a soap. Sulphonated castor and sulphonated mineral oils are also present in modern cutting-oil emulsions. **Pulleys** are moulded from a phenolic resin, around a ball bearing into which the resin is not allowed to penetrate. Recent patent, B.P. 488,295 (J. Wheway (to Lorival Mfg. Co.)) **Rubberflex pillow block,** made by SKF Industries, Inc., U.S.A., is now in great demand. New unit comprises a self-locking bearing of the well-known SKF Grip-lock type. This bearing is inherently aligning, thus compensating for inaccuracies of set-up and conditions of shaft misalignment without binding or in any way impairing the load-carrying capacity of the bearing. In addition, the use of this unit brings about manufacturing economies because it requires no machining of the shaft. The bearing is encased in a pressed-steel housing equipped with felt seals to exclude dirt. The housing is provided with means for lubricating the bearing. The bearing and housing are surrounded with an elastic material having special sound-absorbing characteristics, and the material has been specially treated to make it impervious to oil and grease. Free from the objectional vibration usually associated with rubber mountings, this unit carries substantial loads under practically all operating conditions. Its construction facilitates mounting. The units are first being released in the ¾-in. and 1-in. shaft

RYEMPLOYS PLASTICS

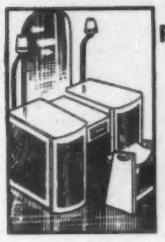
sizes. **Plastics over metal** described in a recent article in *Prod. Eng.* 107-8 (March, 1939). The problems involved in the moulding of plastics over metal are discussed. The process permits utilizing the strength and rigidity of steel plus the noise-deadening, translucence, depth of colour, softness and warmth to the touch, and other qualities of plastics not attainable by enamel finishing the metallic surface. **Light-weight eye shield** made by Boyer-Campbell Co., U.S.A., has a 4-in. by 9-in. Plastacele visor, which hinges upward to a fibre crown when not in use. Aluminium binds the transparent front permitting individual shaping. This shield is used by ordinary acetylene and flash-butt welders and other workers in hazardous jobs.

ELECTRICAL

Bakelite laminated tube used to an increasing extent for insulation purposes in modern electrical equipment. One of the most interesting of recent installations is the new switching station at Lydney on the South-West Grid Scheme, where the Metropolitan-Vickers Electrical Company supplied three 132KV impulse oil circuit breakers. Full details of design and operation of new breakers in *Electrical Times*, 4/5/39. **Circuit breaker tubes** now being made by slicing a block of cellulose hydrate sponge, impregnating the resulting sheet with urea-formaldehyde winding in cylindrical form and hardening. German patent, 662,151, Allgemeine Elektricitäts-Gesellschaft. **Flameproof foils** are made of gelatine, casein or a cellulose plastic, which are flameproofed by impregnation with an amine phosphate. **Insulated wire** now being made by wrapping wire, bare or wrapped in paper or silk with several layers of a cellulose or cellulose derivative foil and then coating with a cellulosic lacquer. The method is described in an Austrian patent 153,398, taken out by Kabelfabrik-und-Drahtindustrie-A-G. **Styrene plastics** now considered of first-rate importance to electrical industry. According to *The Industrial Bulletin*, U.S.A., the electric insulating properties of this resin are superior to those of any other, and it may be immersed in water for months with no change in electrical properties. The resin is characterized also by excellent moisture resistance, extreme dimensional stability, water-white colour and clarity, relatively high softening point, and good abrasion and impact resistance. Although slightly brittle and subject to occasional surface crystallization, these defects may later be overcome, in which event the resin may be used for aircraft windows. Like cellulose acetate, by far the most important plastic for injection moulding, styrene is thermo-plastic and is ideally adapted to that type of moulding, as no plasticizers are required and the softening point cycle is short. In addition, it offers a 15 per cent. saving in weight compared with cellulose acetate, and a 40 per cent. saving compared with the cheaper phenol-formaldehyde resins widely used for compression moulding of electrical parts. **Conductors** can be insulated with a layer of asbestos impregnated with a compound comprising a mixture of resinous phenolic condensation product and a chlorinated diphenyl, such mixture being an elastic solid at atmospheric temperatures. According to B.P. 500,257, the compound may comprise equal weights of Bakelite XR8430 and Aroclor No. 1262, such materials being mixed at 160 degrees Centigrade. **Large-base Bakelite ceiling roses** and lampholders just been introduced by The General Electric Co., Ltd. These dispense with the old-fashioned wood block and give a more pleasing appearance and saving time and labour costs. They can be mounted directly on the ceiling or directly on the conduit box and have standard 2-in. fixing centres to suit British Standard Specification conduit boxes. They are available with either Bakelite or porcelain interiors and range in price from 6s. per dozen to 10s. for three-terminal type.

CHEMICAL

New solvents for synthetic resins and cellulose esters are the nitroparaffins. According to *Industrial Bulletin*, April, they are nitromethane, nitroethane and four other materials, all colourless, heavy liquids with mild odours, which boil in the useful range 212-300 degrees F. They are direct and active solvents for nitrocellulose and a wide range of synthetic and natural resins. Mixed with alcohols they are solvents for commercial cellulose acetates, whilst nitroethane is a heat sensitizer which brings about the gelling of rubber latex. The chlorinated nitroparaffins are attracting attention as anti-gelling agents, useful in rubber cements. It is expected, however, that the nitroparaffins will find their greatest use as raw materials for further chemical processing. Their ammonia derivatives appear to be very promising, while the nitroalcohols can be used with fatty acids to form emulsifying agents. The first commercial unit of American plant expected to be in operation this year.



FURNITURE

Liquid resin adhesives can now be used to greater advantage in the plywood industry by means of a new type of spreader described in *Timber Trades Journal*, May 13. The machine was developed in America. It has rubber rolls, is ball-bearing throughout, and is equipped with sensitive and accurate micrometric adjustments. The end frames are of the rigid box type firmly joined at top and bottom. Scraper rolls are made of ground and polished steel, slightly smaller in diameter than the gluing rolls; they run on sealed ball bearings and are controlled by over-running clutches. The drive is of the highly efficient hardened and ground roller-chain type, fully enclosed in the case on the left frame; it is automatically self-compensating in all positions. The glue reservoirs are formed by the space between the gluing and scraper rolls and two drip-proof end plates of special design. The reservoir on the upper roll is on the infeed side and the lower reservoir on the opposite side of spreader.

AIRCRAFT

Sparking plug for the Plane Bonnet aeroplane now moulded of Makalot phenolic resin, made by the Makalot Corporation, 262, Washington Street, Boston, Mass., U.S.A., the special grade of resin used for this difficult job possesses high dielectric strength, arc resistance and low loss qualities of an exceptional degree. **Balloons** will, it is anticipated, be soon made of synthetic rubber if the verdict of the United States National Bureau of

Standards is considered. The Bureau has reported to American Naval authorities that the material is far less permeable than natural rubber, although, of course, mixture with textile fibres tends to increase the permeability. Paraffin-wax and toluol are recommended as suitable for making balloons of synthetic rubber less permeable.

AGRICULTURE

Acrylic resin from lactic acid produced from milk, according to recent issue of *Manchester Guardian*. Experimental work carried out at the Bureau of Dairy Chemistry of the United States Department of Agriculture. It is claimed that the production by this method is as cheap as that by the cyanhydrin process which starts from ethylene or alcohol. A new cheap source of raw material for the manufacture of lactic acid has been found in lactose of whey, a by-product which is obtained in excessive quantities in the manufacture of cheese and casein. It is doubtful in the present state of research whether the new process for making resin will be used on an industrial scale, but the experiments of the American office have been concerned with the systematic research of different avenues which promise to create new outlets for milk products rather than with their immediate commercial utilization. **Mechanical milking** now made easier by use of transparent resin teat cups, first used in America and made by General Electric of Textolite for Ben. H. Anderson Mfg. Co., Madison, Wisc. According to information just received, use of pure resin for this purpose is important as it enables dairyman to watch milking operation and see that teat is milking properly. Smoothness of finish makes for easy cleaning and purity of milk, and also renders the teat more comfortable for the animal. It is claimed that the natural warmth of the transparent resin teat is an important factor and facilitates easy milking. **New meat-wrapping** process now being developed by the Dewey and Almy Chemical Co., Cambridge, Mass., U.S.A., who are using the Cryo-Vac method. This consists of using a specially compounded latex that is odourless, tasteless, moisture and vapour proof, in the form of a balloon-like envelope. It is blown up by stretching the wide mouth over a frame or can and a vacuum is drawn around the outside. Thus, the wrap takes the shape of the cylindrical container into which it has been drawn, while the chilled sides of the container "freeze" it into expanded size. Into this expanded, open-end "package" a chicken (or other meatstuff) is lowered, following which a vacuum hose removes the inside air and draws the wrap close to the solid. The neck of the wrap is then twisted and clamped to make the whole vacuum pack thoroughly air-tight and vapour proof. The final operation calls for the immersion of completed package in warm water, the effect of which is to "thaw" the "frozen" rubber so that the wrap attempts to shrink to its original size and this forms a taut, transparent wrap around the chicken or carcase. Details in April issue of *Rubber Age*, U.S.A.

MOTORS

United American Bosch Corp. now using Makalot phenolic resin for moulding their four and six-cylinder distributor plates. The resin is specially made so that it will not disintegrate or damage in any way as the result of natural expansion or contraction of the large metal insert due to temperature change. Northern Industrial Chemical Company of Boston, Mass., U.S.A., are carrying out the moulding for Bosch. **Ignition cable** of commercial vehicles now insulated with neoprene by Packard Electric Division of the General Motors Corp., U.S.A. Claimed that new insulation able to withstand action of ozone and deteriorating effect of oil, heat and abrasion under all conditions of service.

Automotive predictions in a recent issue of *The Wall Street Journal* are of interest to manufacturers. Author, Harlan B. Hadley, anticipates greatly improved motors, power plants that will be more efficient in terms of power per pound of engine weight and in terms of miles per gallon of fuel, although he believes that speed ranges will be about the same as at present. Front ends will be wider and rears narrower. Front seats will easily accommodate three and possibly four passengers, says Mr. Hadley, and back seats will handle two to three passengers. Sedans will be built to carry six passengers with the same comfort now afforded five. Outside body dimensions will be no larger and possibly smaller than present ones. Interesting is the prediction that plastics will be more widely used. There is, of course, the natural assumption that they will replace some of the glass used in cars. There is the possibility that the new German Volkswagen, which has a plastic body, may spur a greater use of plastic materials in the U.S.A.

BUILDING

Sanitation for air raid shelters now makes use of plastics. Elsan chemical closets, A.R.P. models, are entirely independent of outside drainage; are neat, compact and unobtrusive; all metal parts are specially treated against atmospheric conditions; and the special Elsan chemical used with these models treats the sewage on the spot, so that its disposal may be postponed for a long period without fear of odour or germ infection, and ensures a safe, hygienic sanitary service. An additional improvement has recently been made. All Elsan A.R.P. models are now fitted with moulded Bakelite seats, because they will not absorb gas (as wooden seats might), and are easy to decontaminate.

MISCELLANEOUS

Rubber casts of rock carvings now used by the Swedish Antiquarian Office. Method consists of spraying a rubber solution over the object one or more times, according to desired thickness of mould. Material dries very quickly and afterwards the thin layer of rubber only has to be rolled from the carving. Such a layer constitutes an excellent and exact casting mould of the carving from which it has been taken; from it any desired number of perfectly sharp and clear copies can be had. According to *Scientific American*, April, 1939, 10 rubber moulds of this type were taken and all turned out extremely well. This novel method seems to have doomed entirely the old-fashioned system by which the carvings were reproduced by means of a plaster cast. **Experimental drums** now made of metal or wood with one whole side of organic glass, such as Lucite or Plexiglas, for observation of the experiment in progress. Such drums claimed to be in use in certain technical schools and universities in America. **Acrylic resins** containing nitro-cellulose is a suggestion made in a recent Canadian patent, 373,763. It may be that by the inclusion of a cheap cellulose plastic a considerable reduction in the price of methyl methacrylate resins will be possible. **Explosive containers** made of Synthane-Risonite, a new type of laminated material manufactured by the Synthane Corporation, U.S.A., now in use in America for shooting oil wells.

ORGANIC GLASSES

WITH SPECIAL REFERENCE TO PERSPEX AND DIAKON

(The above photograph shows Diakon moulding "powder" under a microscope.)

Optical testing of Perspex.

THE group of synthetic-resin polymers which includes the acrylic and methacrylate resins is actually one of the oldest historically, but one of the youngest industrially. The spontaneous polymerization of acrylic esters was noticed as far back as 1873, but their commercial development (resulting, in part, from wartime research on ethylene and acetone as raw materials) properly belongs to the last decade. The methacrylates, which probably enjoy the widest use and offer the most interesting possibilities, are produced commercially in Great Britain under the trade names of Diakon and Perspex. Dr. Otto Röhm appears to have been the first to recognize the potential industrial value of transparent synthetic resins of this type by his sustained interest in acrylic resins from 1901 onwards.

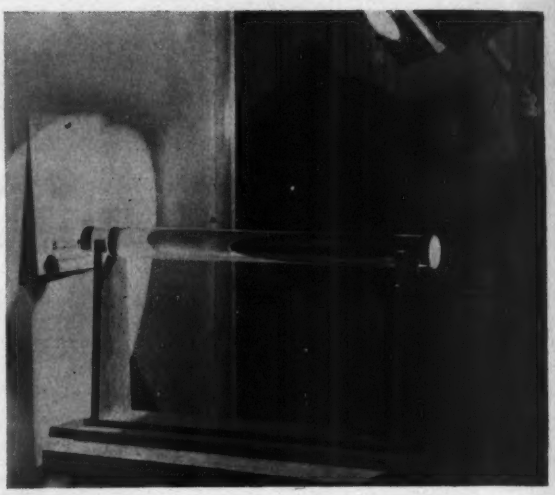
These products are characterized by their freedom from colour, remarkable transparency, great strength

Simple forms made from the cast sheet Perspex.

and stability, resistance to chemical attack, and the variety of ways in which articles can be fashioned from them, e.g., by moulding, machining and carving.

Manufacture

There are several methods of synthesis of the methacrylate resins, but in all of them the raw materials of manufacture are simple and readily available. The principal raw materials are methanol, hydrocyanic acid and acetone. Methanol is made in this country by the well-known pressure synthesis from hydrogen and carbon monoxide extracted from water gas. Hydrocyanic acid is made from ammonia, itself synthesized from the nitrogen of the air and hydrogen, again obtained from coal as the ultimate raw material. Acetone can also be made by methods based eventually on coal—for example, from oil-cracking gases. Thus, the ultimate raw materials of Perspex and Diakon, the I.C.I. methacrylate resins manufactured at Billingham, are, in effect, coal, air and water.



(Above) Print can easily be read through a cast rod of methyl methacrylate resin.

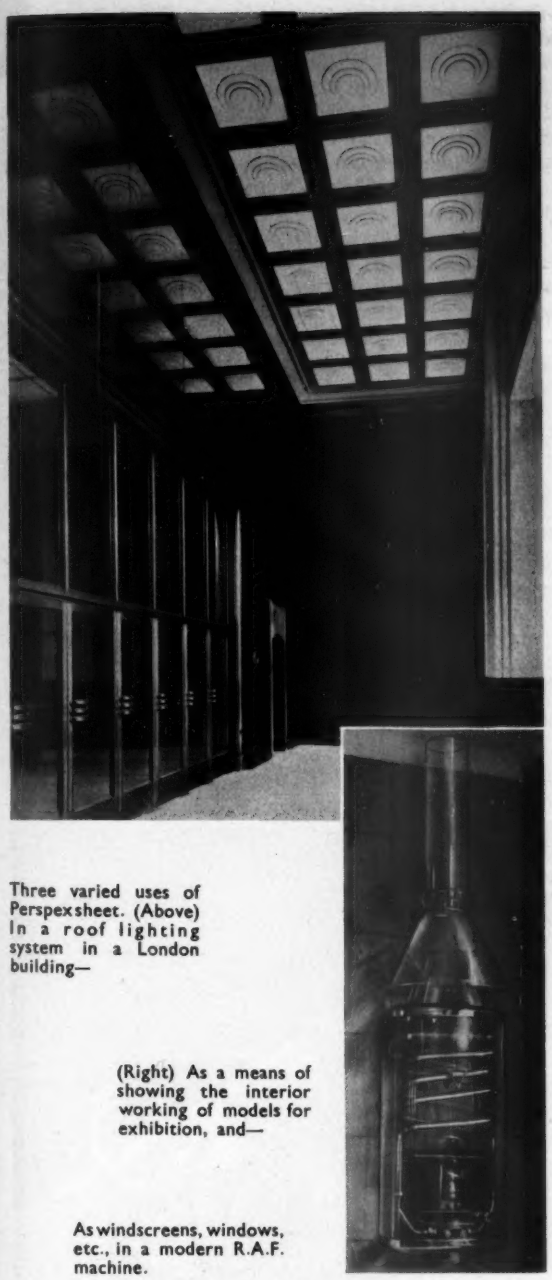
(Left) Lathe-turning operations on solid rod or tube.

(Below) A good example of the ability to manipulate Perspex by carving is seen in this buffalo.

The actual resins are, in these instances, the polymers of methyl methacrylate. Methods of polymerization vary in details, but they all result in the transformation of the original clear liquid methacrylate into solid, highly transparent resinous substances which are thermoplastic, as distinct from the thermo-setting resins of the phenol- and urea-formaldehyde types. In general, polymerization takes place directly under the influence of heat or light, and can be assisted by oxidizing catalysts. Polymerization can be so controlled as to take place during casting in suitable moulds, to sheets, rods, tubes, etc. It can also be carried out in solution in solvents or in emulsions, or else the original methacrylate can be polymerized while temporarily dispersed as droplets in a non-solvent; polymerization under the influence of light in the vapour phase has also been studied. Afterwards the resin can be disintegrated into moulding power to produce Diakon.

The most outstanding properties of the thermoplastic resins so obtained are:—

1. Unique clarity and transparency and remarkable optical properties generally.
2. Excellent stability to light, and resistance to a wide range of chemical reagents.
3. Excellent mechanical strength and shock resistance retained at all temperatures and humidities likely to be experienced under the most adverse climatic conditions.



Three varied uses of Perspex sheet. (Above) In a roof lighting system in a London building—

(Right) As a means of showing the interior working of models for exhibition, and—

As windscreens, windows, etc., in a modern R.A.F. machine.

4. Permanence of transparency and shape in hot, cold, wet or dry climatic conditions.
5. Excellent mouldability at a high softening temperature.
6. Good electrical properties.

The light transmission of Perspex is substantially higher than that of even the best-quality optical glass, and this property is retained in sunlight and under conditions of high ultra-violet light intensity. The new standards of clarity which it has set have abolished any limitations in the thicknesses in which it may be used. Moreover, Perspex is among the lightest of transparent materials, its specific gravity being 1.19, as compared with 1.35 for safety celluloids and 2.5 upwards for glass.

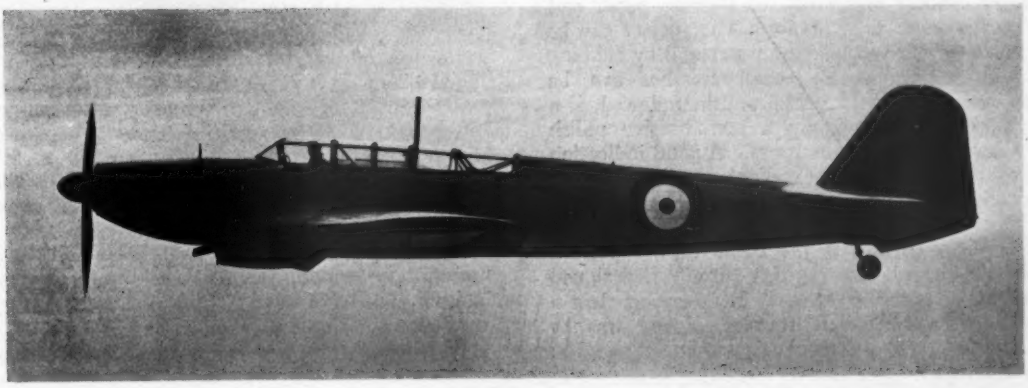
Its excellent dimensional stability and the fact that it shows no shrinking or warping due to age or exposure to varying atmospheric conditions have been utilized to good effect in many engineering and constructural trades. Its moisture absorption is very low and it is unaffected by sea water. Its expansion and contraction over wide temperature ranges conform accurately to known data. Its toughness is retained at low temperatures, as will be seen by the fact that its impact strength at room temperature (16 degrees C.) is 4.0 kg. cms., and that at −40 degrees C. 4.3 kg. cms.

Perspex is not attacked by concentrated alkaline solutions or mineral acids in less than 30 per cent. concentration. It is insoluble in aliphatic hydrocarbons and hydrogenated aromatic compounds, and is unaffected by simple ethers and by oils and fats. Ozone and sulphur dioxide have no effect on Perspex over long periods, but aromatic hydrocarbons and chlorinated solvents attack it to varying extents. It is worth noting, however, that ethyl alcohol of less than 50 per cent. strength is entirely without effect. As an electrical insulator Perspex is superior to the more common plastics of the phenol-formaldehyde and urea-formaldehyde types.

The very low thermal conductivity of the material gives it a very attractive warm feel.

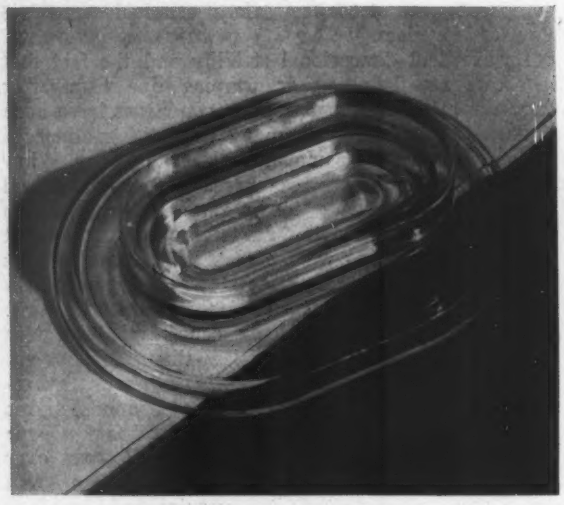
Working Details

(a) *Perspex.*—Perspex, the pre-cast sheet form of the methacrylate resins manufactured in this country, is available in a variety of thicknesses and sizes. For example, the standards normally sold are 3/32-in., ⅛-in. and 5/32-in. thick in sheets 48 ins. by 36 ins., and $\frac{3}{16}$-in. and ¼-in. thick in sheets 54 ins. by 48 ins. The thickness is not restricted to the above sizes, since $\frac{1}{16}$-in. and 1-mm. thicknesses have been made. These latter thicknesses are merely not



stocked and are made on request. Perspex can be cut, carved, engraved, stamped, turned and milled, machined and shaped. Cutting may be carried out with a high-speed band or circular saw, any tendency to cracking being lessened by warming, with care to avoid local overheating. It can be drilled with ordinary drills under the same conditions and can be turned upon ordinary engine lathes. Milling is carried out with standard cutters, run fast and well lubricated with soluble oil.

Perspex is a true thermoplastic, i.e., when heated to the right temperature it becomes pliable and



Bulkhead lights moulded from Diakon by Ebonestos, Ltd.

can be shaped. In general, shaping is carried out by existing techniques as used for forming safety celluloid sheet material, with appropriate adjustment of temperature and time of heating or cooling. The best method of heating to working temperature is to hang the Perspex by means of clips, in a constant-temperature air oven. The temperature at which it should be worked is largely dependent on the type of pressing to be undertaken. Since softened Perspex will take on the form or surface markings of any mould on which it is pressed, a perfectly smooth mould is necessary to obtain perfect impressions. In this way a remarkably fine surface finish can be obtained with Perspex, and injury to its inherently good optical qualities is avoided. Perspex can be buffed with a cloth of the silver-finishing type and edges can be polished by rubbing first with No. 1 emery paper and then with a series of finer grades. The surface can be readily cleaned with warm soapy water and by rubbing gently with cotton wool. Small scratches can be removed by polishing with metal polish, followed, if a perfect finish is required, by a non-abrasive polish specially developed for the purpose. A good indication of surface retention is the excellent condition of the Perspex observation car in the L.N.E.R. Coronation Scot.

(b) Diakon.—Diakon is the name of the powder or grain forms of the British product designed for moulding in suitable presses. It is marketed in a wide range of transparent, translucent and opaque colours. From these thermoplastic moulding powders can be moulded objects of utility and beauty, combining strength with lightness and transparency. Mouldings have all the desirable properties already listed in connection with Perspex, i.e., they do not distort in atmospheres of high humidity, they are resistant to chemical attack, they are easily machined, and they may be cemented together with clear transparent joints. Whilst somewhat resembling the polystyrenes in transparency, the tensile strength of Diakon mouldings is 100 per cent. greater. Diakon is more transparent than cellulose acetate and is not so liable to warp or crack. It is available in different grades for compression and injection moulding.

Moulds should be of the positive type and the coring carefully designed to ensure uniformity of heating and cooling.

Uses

(i) *The Aircraft Industry.*—Perspex is increasingly replacing laminated safety glass and cellulose-acetate sheet in modern aircraft design, in which such fittings as windscreens, cockpit covers, turrets and other important transparent structures have assumed greater structural importance with the increased performance of modern aircraft, which has necessitated the closing in of crews to a greater extent than ever before. The lightness, safety and good optical properties of Perspex are such that it is chosen for all structures which are required to combine adequate protection with high visibility. Additional valuable features are the ease with which the plastic is shaped

Examples of fancy containers moulded from Diakon "powder."

and the fact that it does not shatter. Moreover, its exceptional clarity, permitting its use at almost any thickness, is retained under the ultra-violet light conditions of high-altitude flying. The material is now standard for windscreens and cockpit enclosures on a number of service and civil types at present in production.

(ii) *Building and Constructional Work.*—These same

properties, allied with its intrinsic beauty and decorative qualities, also open up interesting possibilities in building and constructional work. As a recent example of the utilization of its decorative possibilities with its structural advantages may be quoted the use of sand-blasted panels of Perspex for the portico roof-lighting system of a large modern building recently completed in London. Incidentally, each of these panels weighs only 10 lb. and, once dropped into place, requires no further fixing.

(iii) *Optical Uses.*—In refractive index and dispersion, lenses of Perspex resemble the finest glass lenses, and their transparency, especially in the ultra-violet, is so high that the loss of light by absorption is appreciably less.

Radio cabinet, moulded of Diakon, to show interior for exhibition purposes.

(iv) *Display Work.*—The exceptional transparency of Perspex and the fact that it lends itself admirably to the device of "edge-lighting," suggest many interesting possibilities for display work, such as for display shelves for jewellery, for backgrounds or mountings for exhibits, and for lettering. Perspex being only half as heavy as glass (and having, indeed, the lightest weight of any transparent material in common use), is worth consideration for large displays and signs. In certain convenient sizes the cost of Perspex is strictly competitive with any other form of transparent material. Larger sheets are naturally more costly. Further, the surface of Perspex can be modified as desired by painting or engraving designs on it or by sand-blasting.

The cost of production of a resin of this type is certainly greater than that of the thermo-hardening phenol and urea types of plastics; but although the complicated nature of its synthesis may prevent costs ever becoming extremely low, they should undoubtedly reach a level at which, in the near future, radio and television sets, telephones and many other of our everyday requirements will make free use of this exceptionally beautiful thermoplastic material.

SPECIFIC PROPERTIES OF PERSPEX

General

Specific gravity at 20° C. ...	1.19
Effect of exposure to ultra-violet light	No visible effect in 480 hrs.
Loss in weight on heating ...	0.3—0.4% after 24 hrs. at 80° C.
Linear shrinkage on heating...	1.2—1.8% after 1 hr. at 105° C.
Water absorption in 7 days at 20° C.	0.3—0.4% by weight on specimen 2 ins. × 2 ins. × $\frac{3}{16}$ in.
Swelling after immersion in water for 7 days at 20° C.	0.3—0.9% increase in length on specimen 8 ins. long × 1 in. × $\frac{3}{16}$ in.

Mechanical

Tensile strength at 20° C. ...	3.2—3.9 tons/sq. in.
Impact strength at 20° C. ...	3.2—4.2 tons kg. cms.
Impact strength at − 40° C. (Izod, cut notch)	4.3 kg. cms. (on specimen in accordance with B.S.S. 488)
Ultimate fibre stress in bend at 20° C.	6.0—7.0 tons/sq. in.
Shear strength at 20° C. ...	4.0—4.2 tons/sq. in.
Proportional limit in compression at 60° C.	1.8 tons/sq. in.
at 40° C.	2.1 tons/sq. in.
at 20° C.	4.8 tons/sq. in.
at −0° C.	5.5 tons/sq. in.
at −18° C.	7.2 tons/sq. in.
at −40° C.	11.0 tons/sq. in.
Compressive strength at − 40° C.	14.5 tons/sq. in.
Brinell Hardness	18—20
Modulus of elasticity at 20° C.	200 tons/sq. in.

Thermal

Martens heat resistance ...	55—60° C.
Thermal conductivity ...	5.0 × 10^{-4} c.g.s. units
Coefficient of expansion per ° C.—	
Between +20° C. and +60° C.	69.3 × 10^{-6}
Between −39° C. and +15° C.	51.0 × 10^{-6}
Between −20° C. and +4° C.	43.2 × 10^{-6}
Between −39° C. and −20° C.	68.5 × 10^{-6}

Optical

Refractive index for Na D line at 20° C.	1.50
Relative dispersion $\frac{N_D - 1}{N_F - N_C}$	57.3

Light absorption.	In the visible range, negligible.	
Ultraviolet: 3,400 A° ...	10%	on specimen 2.3 mm. thick.
3,300 A° ...	22%	
3,200 A° ...	24%	
3,100 A° ...	30%	
3,000 A° ...	38%	
2,900 A° ...	56%	

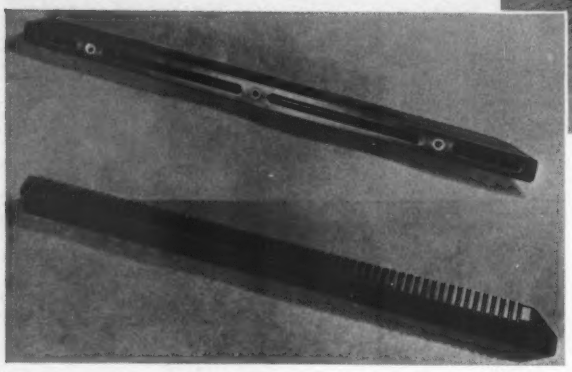
Electrical

Breakdown voltage on specimen $\frac{1}{8}$ in. thick	390 volts/mil. after 24 hrs. in an atmosphere of 75% humidity. 380 volts/mil. after immersion in water for 24 hrs.
Permittivity at 10^6 cycles ...	2.8
Power factor at 10^6 cycles ...	tan δ = 0.02

Plastic Treads for New Escalators

Nearly 20,000 moulded slats are used for the treads of Harrods' new escalators at their Knightsbridge store

View of escalators, showing the plastic treads and lovely anodized aluminium casing.



Close up views of the moulded Bakelite slats. Notice the top picture showing positions for screws.

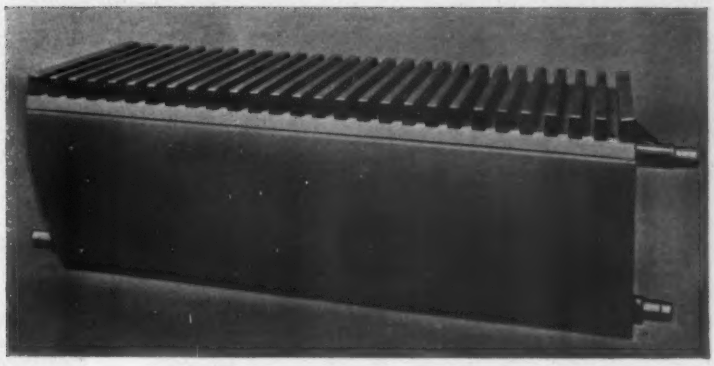
MORE than seven years ago J. and E. Hall, Ltd., Dartford, started to build escalators to the designs of Messrs. Carl Flohr A.G., of Berlin. One of their first and most ambitious orders was for Bentalls, Ltd., of Kingston-on-Thames, and so successful was this particular installation that it opened up a large and promising field for specially designed escalators in other large departmental stores throughout the country, especially as it brought home to the latter the low running and maintenance cost of escalators as compared with lifts.

Until recently metal and wood were the sole materials used for the construction of escalators, with the exception of the moulded plastic rollers supplied by the British Thomson-Houston Co., Ltd. It was, however, realized by J. and E. Hall, Ltd., that other materials, particularly plastics, might one day be of interest where there was a special demand for a durable and decorative material in place or partially in place of wood. In the case of their recently completed contract for Harrods, Ltd., Knightsbridge, the need arose for escalators of outstanding characteristics in the way of decoration, durability and silence. Here, obviously, was an opportunity for plastics and at once the technical staff studied the whole question in the light of these new materials.

The economics of production were carefully studied, but it was found that to mould the complete tops of the platform would be too costly. A compromise was arrived at which consisted of moulding slats of Bakelite and fixing these to a laminated wooden board measuring 343 by 780 mm. veneered with black $\frac{1}{16}$-in. Bakelite sheet. Exactly 19,348 slats were needed for the 691 steps, each one having 28 slats. The advantage of this form of construction over a completely moulded top is that individual slats can be replaced when worn or damaged without incurring the cost of renewing the whole top of the step.

These slats, moulded by Ebonestos Industries, Ltd., Excelsior Works, Rollins Street, London, S.E.15, measure 343 mm. long, 25 mm. high and 13-15 mm. thick and they have a serrated edge to give a firm grip on the sole of the shoe. Their jet black colour and smart finish harmonize perfectly with the beautiful anodized aluminium casing supplied by J. Starkie Gardner, Ltd., art metal workers, and in this respect the novel application of plastics more than fulfils all requirements. From a maintenance standpoint plastics leave little to be desired. They are permanent under all conditions of service and, unlike painted or lacquered wood, they never require any treatment and retain their clean colour indefinitely. This is a very important consideration and was one of the reasons why Bakelite was chosen in place of coloured beech wood strips. The latter is a particularly hard wood and hitherto used for the steps of the escalators.

The silencing of the Harrods escalator was achieved by an entirely new method. The metal step rollers were fitted with special solid rubber tyres vulcanized to the metal hubs. Much research was required to determine the correct composition of the rubber and the best method of obtaining a satisfactory adhesion to the



The moulded slats fixed in position on the black Bakelite veneered wooden step of the escalator.

metal hub: The Dunlop Rubber Co., Ltd., and the Harborough Rubber Co. were responsible for this work after exhaustive tests to destruction over a long period had been carried out by J. and E. Hall, Ltd., on a special machine constructed for the purpose. The result obtained by use of the new rollers can be tested by any visitor to Harrods, who cannot help noticing the exceptional silence and smooth running of the escalators.

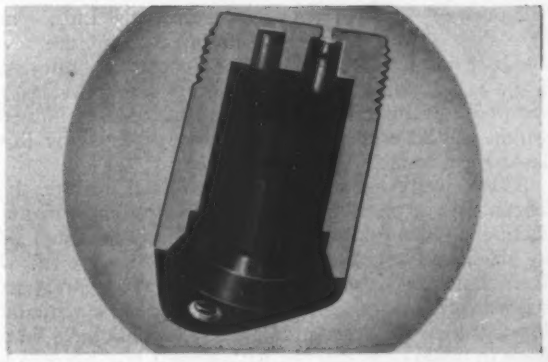
It would appear that this interesting and important application of plastics in escalator construction points the way to other applications in the same field. We see no reason why decorative laminated sheeting, embodying textiles or wallpaper, should not be used for the sides of the escalator and in conjunction with anodized aluminium we should imagine some very original and striking effects could be produced. Then again, there is no reason why only black moulded or laminated slats or platform tops should be used. A wide variety of colours are available and, in the case of the cinema or departmental store, we consider that colour contrasts or harmonies might be very welcome. These are, however, suggestions which may or may not prove feasible in practice. The main point to stress is that plastics are to-day being considered for important architectural and engineering work as alternative materials to wood and metal and not as substitutes. Wood is perfectly serviceable, but for this use it has its limitations where decoration is concerned and only a versatile material, like plastics, can hope to fulfil requirements.

Neoprene in the Air

The "Yankee Clipper," which made the first Atlantic flight for Pan-American Airways, contained several neoprene parts in its mechanism, notably neoprene PAW sealing tape and the moulded neoprene magneto gear used in the Pratt and Whitney engines. The sealing tape is necessary for sealing the joints in the hulls and pontoons, and it eliminates the necessity for bulky sealing equipment. It makes durable joints in a riveted assembly and has excellent resistance to oxidation, sea water and sunlight. The magneto gear is used in contact with hot oil and forms a flexible coupling between magneto and engine. It gives thoroughly reliable service. While there are other potentially larger outlets for neoprene in aircraft construction, the examples given are ample proof of the versatility of its performance. Neoprene packing is now being employed on new high-pressure cooling systems in modern aircraft, where service conditions demand flexibility combined with resistance to high pressures and resistance to water, oil or glycol at high temperatures.

An Unusual Mould

We are always interested in novel designs and in the engineering world in ingenious mould construction. The accompanying illustrations (top view and cross-section) show a difficult moulding job recently completed by the Auburn Button Works, of Auburn, N.Y. The specifications for this small socket called for two inside undercut "L"-shaped slots, unusually close tolerances throughout, rugged construction and dependable insulating properties under varying atmospheric conditions. The entire unit was moulded in one piece of black Bakelite. Threaded base, the "L"-shaped slots and two screw inserts were all moulded in one operation, the unit emerging from the moulds as shown here. The moulding of the undercut slots presented a difficult engineering problem requiring a very unusual mould construction. However, Auburn engineers solved it to the satisfaction of everyone concerned. We heartily congratulate them on their ingenuity and skill in overcoming all difficulties.



Top view and cross-section of the Auburn socket.

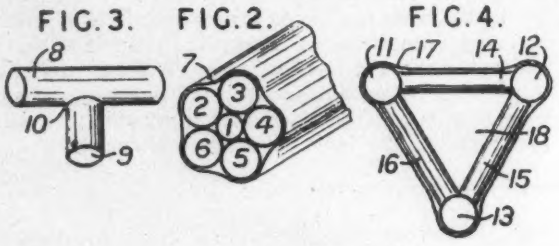
Ideas—

By the EDITOR

Cellulose for Aircraft

We have all heard of cellulose acetate sheet being extensively used in aircraft as windscreens, hoods, turrets and windows, but the suggestion that, in tubular form, cellulose acetate might be employed as a real unit of construction for aircraft is very new to me. E.P.497,766 deals with this subject as follows:—

Light structures, such as parts of aircraft, are formed from tubes made of cellulose derivative, e.g., acetyl cellulose, which may be reinforced by metal wires or fabric and are stuck together by acetone, methyl alcohol or other solvent. The tubes 1 . . . 6, Fig. 2, may be arranged in bundles with their axes parallel, the



assembly preferably being provided with an enveloping jacket 7 of sheet cellulose acetate or of paper, etc., impregnated or coated with cellulose derivative. Fig. 3 shows two tubes 8, 9 stuck together at 10 to form a T-piece, and Fig. 4 a structure comprising longitudinal tubes 11, 12, 13, connecting cross tubes 14, 15, 16 and a jacket 17. The hollow spaces inside the tubes and/or between them and/or between the tubes and the jacket 7 or 17 may be wholly or partly filled with a light porous substance, such as solidified glue foam, and the jacket is preferably coated with gum lac or other waterproof varnish or with a mixture of a cellulose derivative with a pigment such as titanium white, lithopone, etc.

Eye-bath Novelty

An eye-bath that drops into the bath and is smashed into 10^n pieces is not good enough. This happened to me last month in real fact. Consequently I was more than pleased when Mr. Wood, of Crystalate, Ltd., sent me, for inclusion in this page, the new eye-bath his firm is moulding for Cooper Laboratories, Ltd., of Watford. The new idea, which provides a screwed-in tube for holding eye-wash tablets housed within the lid of the bath, has been patented by this last-named firm.

This novelty exemplifies in a brilliant manner the advantages of plastics, not only in utility, but in manufacture. If we want an unbreakable bath it cannot be in glass, and yet, I presume, nearly 100 per cent. of them have been so constructed. Furthermore, the screw-in tube, in a tight-fitting lid, would be virtually impossible of construction in glass. It could have been done in metal or wood, but with a great loss in appearance and only by using a minimum of four or five parts

soldered or screwed. In the plastic example there are only three separate parts, each of which has been moulded in one shot, all fitting within one another.

A small gadget, but a big lesson!

Moulded Soap Dish

An American once informed me, in a fit of righteous anger, that were it not for America we Englishmen would never wash ourselves. I feel sure that there is some truth in this; at least, I mean that America—or, rather, the American film—has taught us to have bathrooms as beautiful as any possessed by Greta Crawford. Otherwise I doubt whether I should have progressed any farther than did my great grandparents, who never possessed any bath at all.

As the photograph shows, the Americans are still in the ascendency in these matters. Certainly I have not yet seen a British plastic soap dish let into the bathroom wall. It is moulded of Lumarith, the well-known plastic made by the Celluloid Corporation, New York City. There is no doubt whatsoever that modern plastics stand up to the humid conditions prevailing in bathrooms. The little handle below, resembling a small towel-roller, is, we are told, a shower-handle, presumably for holding oneself steady at the shock.

VALUE

A penny to spend. What will you buy? You have more than a penny to spend but your problem is the same. Will your job stand the high priced material, the medium or the low? From the I.C.I. range you can select the most economical material to do your job, knowing that whatever the price you will be getting full value for your money.

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M.39

THE NATIONAL SAVINGS SERVICE

PROVIDENT SCHEMES

For employers who wish to help their employees to make provision for retirement, incapacity or death, the National Savings Provident Scheme will be found ideally suitable. It is also suitable for employers who wish to help women employees to provide for marriage. The Scheme has recently been extended by the introduction of a Reserve Fund to augment the amounts available for special cases. There has also been an improvement of method which makes the operation of the scheme very simple and economical.

The National Savings Committee will be pleased to submit Provident Schemes specially drawn up to meet the particular circumstances of any employer.

HOLIDAY CLUBS

The granting of Holidays with Pay is leading to a considerable increase in the number of National Savings Holiday Clubs. These Clubs can be used not only for personal savings by employees, but also for the accumulation of Holiday Pay Allowances, where desired, by the employer.

Holiday Savings Clubs can be used by any firm, whether the employees all go on holiday at the same time, or at different times. Model Rules have been drawn up to help Clubs to ensure safe working. A Club's funds are deposited in the Post Office Savings Bank or in a Trustee Savings Bank. All material for working is provided free.

Further particulars will be given on request. Enquiries should be addressed to the

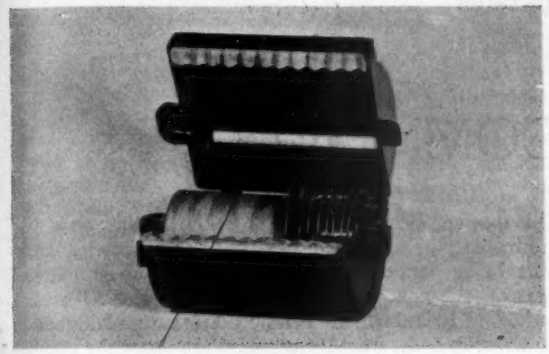
NATIONAL SAVINGS COMMITTEE

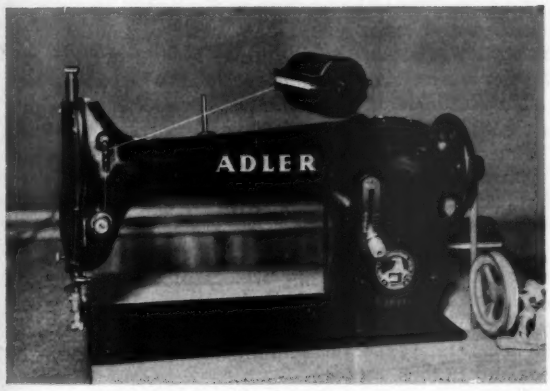
(REF. V23A), LONDON, S.W.1.

New Bobbin Holder

A Dr. Nissen, of Berlin, has sent me details of a new type of bobbin holder, the "Stepp-Fix," moulded of synthetic resin, the British licence for which he wishes to dispose of. It apparently overcomes the numerous inconveniences which trouble the users of industrial sewing machines—snapping of thread, entanglement, irregular winding, and so on.

The new bobbin holder consists of a moulded hinged casing kept closed by spring pressure. The bobbin itself is held in position on an axle. A brake plate is





fitted to this axle by a compression spring, which presses lightly during the unwinding of the bobbin. This prevents falling of the thread and gives the bobbin sufficient tension to hinder it turning when the machine is stopped. The broad guide slit through which the thread is drawn is lined with felt strips which smooth the thread.

The closed casing protects the bobbin from outside dust and dirt, and likewise prevents the contamination of outside goods by oil when an oil-soaked bobbin is used.

Needle Sharpener

As a rule the gramophone industry finds little opportunity of using plastics outside the record itself. However, here is an ingenious accessory for the sharpening of non-metallic needles recently patented and placed on the market by Alfred Imhof, Ltd., of 112-116, New Oxford Street, London.

The fibre needle is placed in the small chuck which grips it firmly and then by holding the handle and putting a slight upward pressure on it, it is moved rapidly to and fro, the end of the needle rubbing on the abrasive strip. The rubber tyre moves over a

roughened track to ensure non-slip and gives more than a complete revolution to the needle. It is claimed that the apparatus produces a point of just the right taper in less time than any other sharpener.

It is interesting to note that the whole of the base, which is moulded in black Scarab by Streetly Manufacturing Co., Ltd., is in one piece, even the roughened tyre track being "moulded in."

Two holes are provided, so that the sharpener can be permanently screwed to a radiogram.

Darts Scorer

South Devon Patents, Ltd., who have produced many ingenious devices in the past, send me along this handsome bit of furniture which we earnestly hope will adorn every "Pig and Whistle" back room in the country. It is the Klok-it darts scorer. The pamphlet which accompanied it tells me that the word is pronounced "clock-it," but as I am so contrary by

nature I shall always call it "Klok-it." It is claimed to be "the quickest scorer yet," but I presume some of the rapidity of scoring must be due to individual skill.

However, the main points are that it is very robust, being moulded from a special resin, and very silent in action, the latter a condition absolutely necessary to the deportment of the game during a needle match.

And since, as the inventors declare, it is "British made and built to last of British Bakelite," what more can you want?

PRODUCTION

Practical Information dealing with Raw Materials, Moulding and Forming of all types of Plastics—Thermo-Hardening and Thermo-Plastic—Works-Organization, New Plant and Control Apparatus

NOTES AND COMMENTS

Machinery for Plastic Manufacture

DURING the month of May, in company of a goodly number of other members of the Institution of the Plastics Industry, we visited the works of Alfred Herbert, Ltd., at Coventry, where a number of special machines for the plastics industry was exhibited. It is, indeed, a good omen for the plastics industry that such a famous concern should now be considered an important adjunct to it.

Our visit was more comprehensive than is inferred in the above statement regarding plastic machinery. It covered the whole of this famous tool-making and precision machinery factory, which we believe to be the biggest in the world, from foundry to the testing of the finished machine. And a miracle of organization and exactitude it all is. Even those who can never raise much enthusiasm for soulless machinery leave with wonder after having seen the production of master parts in which no tolerance is allowed at all, the cutting of gears of all shapes by automatic machines, or the grinding of steel plates 20 ft. long.

As for the plastic machinery on view, we must first mention the Reed-Prentice fully automatic injection machine which is having such success in this country. This received closest attention from the visitors, as it was producing four combs at a time and at a high rate. They were being handed out to the onlookers as souvenirs! Bexone, the new vinyl acetate made by B.X. Plastics, Ltd., and Erinofort, the cellulose acetate powder made by Erinoid, Ltd., were being used to produce the combs. The machine is entirely self contained, with a variable cycle time from 10 seconds up to 2 minutes, and can be operated by hand, semi-automatically or fully automatically, as required. Induction type of heating unit enables a rapid start and an even heat to be obtained.

The Reed-Prentice is made in four sizes, the weights per shot being 2, 4, 6 and 8 oz. respectively. When the machine was producing the combs during our visit, four were made at every shot and in 20-sec. cycles, so that, normally, about 700-750 combs can be produced every hour.

In addition, there was a Stokes Automatic moulding machine for thermo-setting plastics of the phenolic or urea type, a process which is slowly growing in favour in this country. This machine moulds parts up to 3 ins. diameter and 1¾ ins. deep and is made in two sizes—10 tons and 15 tons.

There were two preforming machines, for making tablets—a Stokes type "B" press and a Daniels press,

A view of the plastics machinery exhibition at the works of Alfred Herbert, Ltd. In the foreground is the Reed-Prentice. Various Gorton machines are immediately in rear.

for both of which Alfred Herbert, Ltd., act as sole agents.

As for toolroom machines, adjuncts to the plastics industry, there were Gorton milling machines, a Daniels 500-ton hobbing press, and a fine example of a Taylor and Hobson Pantagraph Milling and Diesmaking machine.

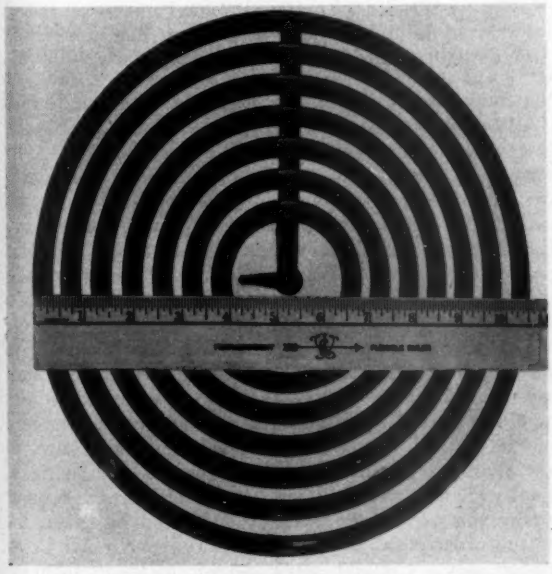
We did not time the making of a die on the hobbing press, but it was remarkable to see one produced out of a cylinder of solid steel about 6 ins. diameter and 6 ins. deep, in what seemed to be about two or three minutes, by merely pressing a hardened master into it.

Large Injection Mouldings

Injection moulding has become such an important part of the plastics industry that most compression moulding concerns also possess one or more injection machines. What is significant is the number of injection machines now available; and, moreover, in spite of the youthfulness of this branch of a youthful industry, questions are already being raised regarding the possible production of large objects by injection, just as the increase in size of compression mouldings was sought for.

Messrs. George H. Alexander Machinery, Ltd., of 82-84, Coleshill Street, Birmingham, 4, who have taken up the agency of the Grotelite injection moulding press, forward us some details of this important machine. Although no example of it has yet reached this country and we shall reserve fuller details till this occurs, it will interest readers to know that, as at present made, it feeds 9 oz. of material, an amount which is considered quite high for injection. It is more interesting to know that another is under construction, which it is hoped will handle larger quantities, and a quantity of 10 lb. has been mentioned. This appears so big for injection mouldings that we are awaiting corroboration. It means, just as with very large compression moulding machines, that we shall be able to tackle jobs in new directions.

For the new Grotelite machine specific advantages of construction, method of feeding and heating, are claimed. For example, the ram which carries the movable die, slides in machined ways and has no bearings whatsoever on the tie rods. This feature permits perfect alignment of the dies at all times. The heating unit consists of a split aluminium housing which can be dismantled in three minutes and contains a "Colrod" heating wire made by the General Electric Co. Situated within this housing is a "pineapple" which splits up the powder into numerous grooves, so that efficient, even heating of it is secured. A Bristol pyrometer controls the temperature.



A test-piece, 10½ ins. diameter, made on a Grotelite injection machine.

The feeding is by hopper and rolls which are operated by the return movement of the plunger. The method of feed-control is unique, since no attempt is made to feed a certain amount of powder at each shot. There are two adjustable cranks, one set to underfeed and the other to overfeed. In operation the plunger moves so far in the cylinder as the material permits, and if underfeeding takes place the plunger travels farther in and actuates the overfeeding crank. More powder is thus fed in and overfeeding then limits the travel of the plunger.

There are no electric controls, thus dispensing with relay switches, delay controls, etc., and the machine can be changed from a semi-automatic to a fully automatic one by the simple lifting of a cam lock.

Walnut Shell Flour

New data regarding walnut shell flour, which may be regarded as a new raw material for plastics manufacture, has been forwarded us by Mr. J. de Miranda, of Amsterdam. Its interest lies not only in the fact that it is available in large quantities (it is stated that 20 million pounds weight of the shells can be obtained each year) and its low cost, but also it is unlike in chemical properties to ordinary wood flours.

Walnut shell flour is homogeneous, fibreless, tough and free from lines of cleavage. It is high in lignin, cutin and cellulose content.

The following are some of the physical and chemical characteristics of the raw material:—

Moisture	6.70 per cent.
Nitrogen	0.10 ,, ,,
Furfural (as pentosan) ...	9.27 ,, ,,
Methoxyl	7.01 ,, ,,
Sugar	0.19 ,, ,,
Cellulose	60.00 ,, ,,
Lignin	29.80 ,, ,,
Cutin	4.20 ,, ,,

In the production of walnut shell flour all meat particles, fins and linings are removed from the shells. The shells are then sterilized and the cleaned particles, too tough to crush by ordinary methods, are pulverized.

This standard product is divided into five stock sizes:—

A—Through 12 on 20-mesh screen.
B—Through 20 on 40-mesh screen.
C—Through 40 on 80-mesh screen.
D—Through 80 on 200-mesh screen.
E—All through 200-mesh screen.

Walnut shell flour, especially the coarser grades, serve as excellent cleaners and polishers in the fur, metal and other industries; also as a producer of voids in fire brick and high-temperature ceramics, and as wearing surfaces in high-grade linoleum and magnesite flooring. A tough plastic product that takes high polish is formed, under heat and pressure, with little binder.

The use of medium sizes in the manufacture of plastics, rubber and high-voltage insulative products reduces weight and cost and increases strength and wearing qualities.

British Packaging Competition

The Editor of *Shelf Appeal* wishes us to remind those manufacturers who desire to enter *Shelf Appeal*'s National Packaging Competition that the closing date is June 24. A special request is made to manufacturers of plastic containers to send in examples of their work.

MACHINING PLASTICS

By P. MABB

THE types of plastics available are manifold, and the forms in which they are procurable to meet the demands of users are numerous. Sheet, rod and tube stock are standard commodities in all the readily recognized materials, such as ebonites, phenolic laminated and moulded plastics, cellulose acetate, amino-resin base materials and casein products, as well as in the less widely adopted acrylic, styrol and vinyl commodities (Perspex, Trolitul and Astralon). For fabrication into components or articles it is evident that machining processes have to be devised for cutting and shaping, drilling and tapping, and that these have to be efficient and economic. The range of plastics mentioned presents a wide divergence of types of base material with respect to rigidity or flexibility, hardness or softness, and, with respect to the tools employed, abrasiveness or wear-promoting qualities. With regard to these variations, one is already familiar with something akin to them in the older constructional materials, such as wood or metal. In the case of wood are encountered soft woods, such as deal; medium hard woods, such as maple and beech; and hard woods, such as oak, walnut and teak. Modification of procedure which has to be adopted from one wood to another is already well known. The same occurs with metals in passing from one alloy to another, or from one temper to a different one in the same alloy. The analogy can be extended to plastics, with particular respect to stressing that the normal fabrication processes of engineering are applicable, but that the group of materials concerned is somewhat different in characteristics from any other group of constructional materials, and that the process envisaged must be studied in relation to the nature of the particular material.

To visualize the far-reaching extent of this subject, it may be possible to illustrate in a general way the fabrication processes involved in producing typical component parts. Consider, in the first place, then, flat parts prepared from sheet. The modus operandi is to guillotine the sheet into strip within controlled limits of width in order to feed through press tools, in which they are blanked to any required profile and pierced with appropriate holes if required. Alternatively, for simple shapes, guillotining limits may be sufficiently accurate, and the cut pieces drilled with holes in the specified positions in locating jigs. Thicker materials in general will have to be cut to size and shape by sawing. Where an edge produced by sawing does not present a sufficiently neat appearance it is finished smooth and bevelled, if required, by milling. Again, holes have to be produced in these thicker materials by drilling. For fixing purposes, either as a means of securing the component to a framework or to an assembly, or of providing a means of attaching other parts to the component, threaded holes produced by tapping may have to be provided. A final type of operation to be mentioned is grinding, which can be applied to the blanked or cut pieces when it is essential to reduce commercial thicknesses to within closer tolerances.

Next for consideration are rods and tubes, which, in many instances, would have to be subjected to turning operations, viz., turning, recessing, threading, boring, parting off. These operations are additional to sawing, milling, grinding, drilling and tapping.

Finally, as a group, mouldings cannot be excepted. Drilling and tapping are the commonest operations entailed on these, but quite a number may be subjected to milling or grinding for specific purposes.

Mention should also be made of straight-graining, polishing and buffing, which, when employed, are chosen essentially as finishing operations for appearance purposes.

Some brief consideration of these fabrication processes will now be given as applied to plastics.

For guillotining, the ordinary machining, as designed for metal cutting, is not ideal. For the sheet plastics mentioned, other than ebonite, thicknesses up to $\frac{1}{8}$ in. can be cut on a properly designed guillotine. The essential difference between the plastics and the metal guillotines is that the upper blade of the former is set at a greater angle to give a more pronounced "scissors action." Also, the angle of rake on the blade is much steeper for plastics, for which this cutting angle is 83 degrees, while the preferred angle between the cutting edge of the blade and the material is 0.5 degrees. Unless these conditions are fulfilled and the blade is kept in perfect condition with respect to keenness, ragged edges will result. If an ordinary guillotine for metal is employed, it is impossible to maintain good edges on the cut material without extraordinary care. Phenolic and amino laminated above 0.020 in. thickness need to be warmed for cutting, controlled heating to 110 degrees C. and 80 degrees C. respectively being required. Concerning ebonite, the common grades of black will be cut hot, a controlled temperature of 80 degrees C. being used. In this case thicknesses up to $\frac{3}{4}$ in. is the range usually manipulated in this manner. The ebonite guillotine is again somewhat different. Only one blade is used, and this is adjusted so that, at the end of the cutting stroke, the edge of the blade just "kisses" a hard wood or copper block let in flush with the surface of the worktable. The blade also differs in form, as shown in Fig. 1. Edges produced in ebonite by this method of cutting are not smooth and are not satisfactory where a good finish is required. Moreover, the ebonite after guillotining is still warm and must be packed with due attention to this fact for the avoidance of warping, or it may be clamped in a bookbinder's press.

For sawing, a special type of saw must be used or an abrasive cutting wheel employed. Band or circular saws may be used and a general average speed would be 5,000 linear ft. per minute and 3,000 revolutions per minute respectively. The pitch of the teeth in saws is an important point, both with regard to producing a good edge and avoiding overheating of the saw. As a guide, the number of teeth per inch can be taken as of the order eight and five for band and circular saws respectively. Circular saws should be made from a good grade of high-speed steel. The latest development for cutting these materials makes use of a saw

bench in which the travelling member is the saw instead of the table. This offers several advantages, as by using pneumatic clamps operating on each side of the saw and arranged to clamp independently over short distances, very secure holding is achieved and very accurate, neat cutting is secured. The clamp can also act as an exhaust duct, and with similar provision beneath the table dust-free conditions for working can be ensured. A saw or an abrasive wheel may be used and the usual working conditions relating to feed and speed are as follow: Cutting speeds range from 1 to 25 ft. for thick to thin material respectively. For example, 0.5-in. thick phenolic laminated can be machined at about 10 ft. per minute and 0.05 in. at approximately 25 ft. per minute. The return speed is about twice that of the feed speed.

Blanking by power press is in general restricted to thicknesses up to $\frac{1}{8}$ in. It is not possible in a short article of this type to deal with the differences in punch and die clearance for plastic materials compared with those used in metal blanking, but it suffices to point out that different formulæ have to be employed for work spacing, width of strip and clearances. Where extremely clean, well-cut, defined edges are required, a tool of the shaving type must be utilized. This latter in effect allows the piece to be blanked slightly oversize, and then a cutting punch follows on in the same tool to trim the part cleanly and accurately. As this is of particular interest, the tooling is shown diagrammatically in Fig. 2.

Difficulties are experienced in maintaining holes to size and in the provision of well-tapped holes; consequently a few detailed notes relating to this aspect are given below.

With all plastic materials there is a tendency for all drilled and punched holes to close in, so that the final diameter is slightly less than that of the tool used to produce the hole. With this feature recognized, it becomes apparent that the design of punches with respect to punch and die clearance and the type of drill used will exert a profound influence upon the result. So far as punches and dies are concerned, the tolerance will vary according to the thickness of the part being pierced and also with the nature of the material and the particular grade involved. Satisfaction in this direction can usually be achieved by the normal tool-room try-out before the tool is released for production purposes.

In the group of materials involved are both thermo-setting and thermo-plastic materials. With regard to the thermo-setting ones, it is appreciated that they are not fully polymerized and therefore some softening of the resin constituent can take place. The friction generated during drilling, combined with the pressure employed, develops sufficient heat to cause a slight softening of the resin, with the result that the swarf tends to clog together and not flow freely along the flutes of the drill. With the thermo-plastic materials, the heat generated in this operation softens them to an extent which causes them to clog the drill in a similar fashion. Again, when laminated materials are being machined, unless the drill is of a suitable type there is a tendency to push the outer laminæ away and cause checking around the holes. Moreover, due to the "closing-in" action mentioned above on withdrawing the drill, the seizure of the laminæ on the drill tends to lift the outer laminæ of the top surface and cause checking around the hole.

These defects, as far as drilling is concerned, are primarily caused by the use of wrongly designed drills. For drilling plastic materials, drills are now produced with long spiral flutes which offer a minimum of resistance to the outward flow of swarf and hence there is little tendency for holes to become clogged. Whenever possible drills with ground flutes should be used. There is a further difference between drills intended for use on plastics and those normally used for metal, and that is that the point is ground to a much more acute angle. The angle for a normal metal drill is 118 degrees and for a bakelite drill is 60 degrees. Therefore the commencing of cutting is more gentle and, similarly, when the drill has passed out of the material there is no sudden break-through.

Tapping of plastic material also presents problems. In this case it is entirely a matter for the operators to receive instructions in the technique to be observed which will allow of well-threaded holes being produced. Only high-quality taps should be used and, when procurable, even in small sizes, ground-thread taps are much the best for tapping this type of material. The taps should never be forced and only gentle pressure applied. In many cases the use of a lubricant is to be recommended; for example, in the heavily loaded ebonites. Special tapping greases have been developed for this purpose and their use not only reduces tap wear and breakages, but also contributes towards the formation of better thread forms. In all cases, of course, both drills and taps must be kept sharp.

Turning of rod and tube materials is carried out on

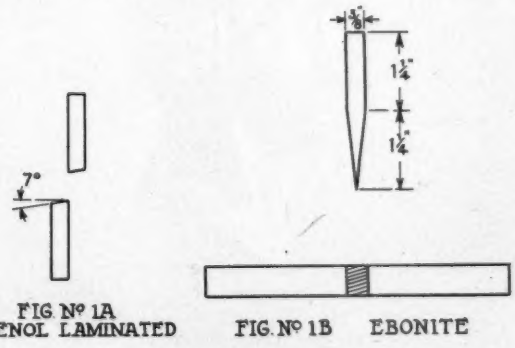


Fig. 1.—Types of guillotine for plastics.

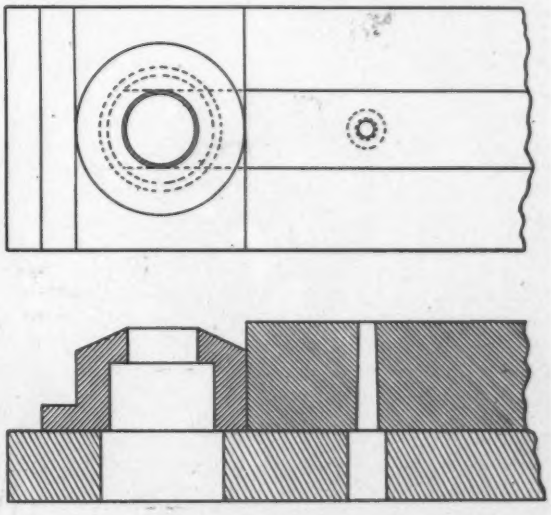


Fig. 2.—Blanking tool for plastics.

the same machines that are used for metal. Tool bits may be used without top rake for all of the plastics with the exception of ebonite and acetate. In these latter cases a slight rake is preferable to permit of the chips falling cleanly away from the cutting edge. A cutting angle of the order of 75 degrees to 80 degrees is desirable on the tools and the clearance rake between tool and work is very similar as for brass, namely, about 12 degrees. Depending upon the operation, cutting speeds will vary from 150 to 500 ft. per minute and depth of cut should never be excessive, especially when dealing with the laminated materials, as there will be a tendency to lift underlying laminations. It is imperative that tools should be kept keen, and seldom is it necessary to employ any lubricant. On occasion a paraffin oil mixture is found to ease matters when ebonites are being machined.

Screw cutting is best carried out with tungsten carbide tools, ground in much the same way as for turning tools with the application of a light sulphurized cutting oil to assist the production of a sharp, clean-cut thread.

For milling, high-speed steel cutters will give the longest life, and it is most desirable that heavy feeds are not employed in order to avoid chipping the entry and exit edge of the work with relation to the cutter. A speed of the order of 400 ft. per minute will be found to be satisfactory, but it is stressed that light feeds should be employed and, once again, it is imperative that tools should be kept sharp.

When grinding to thickness limits on small areas a cup wheel is found to be necessary, because the cutting surface in contact with the material is small and there is ample room for the dust to escape. The dust is carried into the work when large cutting surfaces are kept in contact. The ordinary general rules for grinding hold good, except that all the plastic materials will tend to embed themselves into the surface of the wheel and cause it to glaze. It follows, therefore, that a wheel of rather a coarse grit must be used to avoid clogging and, as with other operations on these materials, heavy feeds and deep cuts must be avoided.

From the outlook of the ultimate user of the plastic article, questions of fabrication must appear exceedingly uninteresting. To the manufacturer they are supremely important. Problems have to be appreciated and rapidly solved; best available methods must always be followed; scrap from damaged components in machining operations must rigorously be avoided: otherwise cost is unduly affected. It is hoped that the above broad survey will be useful, not only to those manufacturers intimately concerned from the practical angle, but will also interest those who are concerned solely with the beauty or serviceability of the finished product. It is always helpful to the industry as a whole for those least concerned to appreciate the problems and difficulties with which others are forced to labour.

WHAT ARE THESE ?

The two beautifully made plaques illustrated here have been sent to us by a reader with the request that we should attempt to discover their origin, for it is stated that they are about 40 or 50 years old. This latter statement, and we do not doubt it, makes many claims for modernity in moulded plaques look rather ridiculous. Without intensive detective work we gather they are of French origin, for both are stamped at the back with the words "bois durci" (hardened wood). What this means is not exactly clear. It seems improbable that the plaques are of wood merely impregnated with a resin and then pressed in a mould. It seems more probable, in view of the fine and smooth reproduction of the heads, that the raw material resembled a modern moulding powder, namely of wood flour and resin. If so, their age is of more than passing interest. It is unlikely that they are of compressed wood as the black colour is more than skin-deep.

Inquiries and Answers

Making Dentures

Johannesburg.

The Editor, *Plastics*.

Dear Sir,—In the last issue of *Plastics* to arrive in this country (April issue), there is an article on simple moulds for the production of simple plastic goods using plaster of paris and "rubber latex" for the moulds. Could you give me further information where "rubber latex" can be obtained and the name of a suitable plastic material for use in such moulds with manufacturers' addresses?

I have taken *Plastics* since its inception, both in England and since coming to this country, as I have used plastics for dentures for several years and thought I might gain tips from your magazine. At the moment I use "Luxene," manufactured by Messrs. Bakelite, Ltd., with great success—in fact, I take the dental depot's entire stock.

Always in my mind has been the idea of getting a way of making the tinfoiling of models unnecessary—would not this material "latex" be suitable, at least for the lingual surfaces? I realize that it would be unsuitable for the palatal fitting surface, owing to the thickness of the deposit. I should be glad if you could give me further information on this.

Also, should you know of other materials such as "Luxene" produced for denture work, I should be glad of the manufacturers' names, etc. P. A. RICHARDS.

[EDITOR'S NOTE.—The reader presumably refers to the casting of liquid resins followed by a hardening reaction. Among the concerns that sell rubber latex are:—Jeavons, Tinto and Co., Ltd., 41, Eastcheap, London, E.C.3, and Peter Spence and Sons, Ltd., Manchester 3.

If information on the methods of preparing latices from special latex powders is required, write to Imperial Chemical Industries, Ltd., Millbank, London, S.W.1.

Latex may be used by means of a spray-pistol or by simple dipping. Careful control of the rubber dispersions is required to obtain the very thin films necessary in dental work.

We have, at this stage, no information with regard to the value of rubber films as compared with tin foil.

As for synthetic resins other than "Luxene," we believe Imperial Chemical Industries, Ltd., supply a special type. We note from a recent patent E.P. No. 498,877, that a mixture of polystyrene and methylmethacrylate resins can be used for making dentures.]

Lamp Shades

Worksop.

The Editor, *Plastics*.

Dear Sir,—I want a material suitable for lamp shades. It must be sufficiently stiff to retain its shape without support, soft enough to cut with a fretsaw, transparent or semi-transparent, and obtainable in a fair range of colours.

Perspex and Pyralin both seem as though they might be suitable, but I do not know the address of the firms manufacturing them. I should be glad if you would supply me with these addresses, and any others that you might think suitable. J. H. PRESTON.

[EDITOR'S NOTE.—Perspex should prove a very beautiful raw material for making lampshades, although the standard thicknesses now available are 3/32, $\frac{1}{8}$ and 5/32 in. in sheets 48 ins. by 36 ins., and $\frac{3}{16}$ and $\frac{1}{4}$ in. in sheets 54 ins. by 48 ins. Thinner sheets are, of course, readily obtainable, but are not stocked normally. Sheets $\frac{1}{16}$ in. and even 1 mm. thick have been produced. The manufacturers of Perspex are Imperial Chemical Industries, Ltd., Millbank, London, S.W.1.

Pyralin is a celluloid sheet made by E. I. du Pont de Nemours and Co., Inc., Wilmington, Delaware, U.S.A.

Cellulose acetate sheet is widely used for making lampshades and is, like Perspex, non-inflammable. It can be obtained in a wide range of colours and designs from B.X. Plastics, Ltd., Hale End, London, E.4; Erinoid, Ltd., Lightpill Mills, Stroud, Gloucester; and May and Baker, Ltd., 42-3, St. Paul's Churchyard, London.]

Polystyrene

London, S.W.1.

The Editor, *Plastics*.

Dear Sir,—The footnote to the letter, "From a Government Department," published on page 164 of the May issue of *Plastics*, strikes us as rather misleading.

To the best of our knowledge our Distrene brand polystyrene is the only polystyrene manufactured in this country. Bexone is the registered trade name of Messrs. B.X. Plastics, Ltd., for vinyl resin moulding powder.

While we appreciate your having suggested polystyrene sheet for the purpose in question, we think that a material more likely to be found suitable is Cellulose Triacetate, which is manufactured by our associate company, British Industrial Solvents, Ltd. Messrs. B.X. Plastics offer this material in sheet form.

HONEYWILL AND STEIN, LTD.
(Subsidiary of THE DISTILLERS CO., LTD.).

[EDITOR'S NOTE.—We regret the misleading information. Bexone, as indicated on p. 194, is a vinyl acetate material. We presume that polystyrene would not be suitable for mechanical strength reasons and that the fully acetylated cellulose would be an improvement over the ordinary cellulose acetate sheet. There still remains also the possibility of utilizing vinyl acetate sheet with which we understand B.X. Plastics, Ltd., are experimenting.]

Switch and Tool Handles

London, S.W.9.

The Editor, *Plastics*.

Dear Sir,—We should be greatly obliged if you would put us in touch with a firm able to supply handles in hard rubber or plastic material similar to enclosed sketch.

We believe handles substantially of this form are in use in the electrical industry on large "Knife" switches.

Alternatively, any kind of plastic tool handles, such as handles for screwdrivers or chisels, may be suitable.

PEAK PATENTS.

[EDITOR'S NOTE.—The sketch enclosed with this letter showed an ordinary switch handle about 5 ins. long and 1 in. in diameter. Most of the manufacturers listed in our Directory, under "Manufacturers of Mouldings," have had considerable experience in electrical mouldings and would be able to advise on the type of raw material to use. Handles for any purpose can be produced without difficulty, including those reinforced with metal for strengthening purposes. If hard rubber is required, we believe Ebonestos, Ltd., have specialized in this type.]

TRADE AND PERSONAL NOTES

Crompton Parkinson, Ltd., Bush House, London, W.C.2, have sent us information regarding their "Klosd" motors for all drives which are now available for ratings from 1 h.p. upwards. A point of particular interest is that new types have been developed for the smaller applications between 1 and 5 h.p. These smaller machines have all the "Klosd" features. The motor is, in effect, enclosed in an outer shell. Between this shell and the inner motor casing is an annular space through which air is forced by a fan mounted on the shaft. The generous space and the velocity of the cooling air prevent dust or dirt settling. There is nothing to choke. All the air, driven over the back of the stator core, provides a cooling system of the highest efficiency.

George Angus and Co., Ltd., Newcastle-upon-Tyne, offer their advice and literature to readers interested in their well-known "Gatex" belting. It is claimed that even soaking with cutting oil does not seriously affect its super-driving power for all machine tools and other drives.

English Steel Corporation, Ltd., Openshaw, Manchester, will be pleased to forward their folder S.T.O.1/3 to anyone interested. It describes the Vickers adjustable reamer, which is suitable alike for precision work, mass production or toolroom use.

The British Thomson-Houston Co., Ltd., Rugby, have forwarded us their new list, AG660, which deals with electric motors and control gear and may be obtained on application to the nearest B.T.H. district office.

The English Electric Co., Ltd., Fusegear Works, Stafford, have sent us their publication No. S.91A, which describes their overhead busbar system. It allows a machine-tool shop power-distribution system to be designed and installed before the machine tools are in position and before the exact positions of the machines are decided. When the machine tools are installed, plug-in fuse boxes containing English Electric non-deteriorating, and high-rupturing-capacity cartridge fuses can be plugged into the nearest available sockets in the busbar chamber which contains six (alternatively nine) sockets per 12-ft. length. When extra machines are installed or the position of existing machines is altered, the plug-in fuse boxes can be inserted or withdrawn without shutting down the supply on the busbars. Safety is ensured by twin earth plugs which make contact in advance of the live contacts.

Messrs. Sutcliffe, Speakman and Co., Ltd., Leigh, Lancs, have forwarded us an illustrated catalogue of self-contained ventilation and filtration units for A.R.P. shelters. The information contained in the brochure is of great importance to employers who are considering the whole question in the light of data obtained from A.R.P. Handbook No. 6, second edition, issued by the Home Office.

The importance of adequate ventilation and filtration equipment can be realized when the following points are considered. Proper ventilation and filtration much decrease the size of a shelter for a given number of persons. This reduces the size of the target and the chance of being hit. The decreased vulnerability applies equally to gas and high explosives. The constructional cost per person protected by the shelter is decreased in the same ratio as the size, and the provision of adequate shelters becomes an economic possibility. A ventilated shelter is normally only one quarter the size of an unventilated shelter for a similar number of persons. Unventilated shelters should be designed on the basis of 100 sq. ft. of surface area (i.e., ceilings, walls and floors) per person to give protection for 12 hours; whereas a ventilated shelter may have a floor area of only 6 sq. ft. per person, and, in exceptional cases, only 3½ sq. ft. per person.

Ventilation and filtration units. These facts have been realized by the A.R.P. Department of the Home Office, who have fixed certain standards of protection and have laid down definite principles of design, with which all plants should comply. All the plants described in this catalogue are designed in accordance with these principles, and a number of the designs have already received Home Office approval.

The British Commercial Gas Association have issued a handsomely produced booklet to show the many applications of gas to industrial purposes. The simplicity and ease of temperature control is emphasized, also its flexibility, cleanliness and adaptability.

Department of Scientific and Industrial Research have now published leaflet No. 4, dealing with benzene in their series describing methods for the detection of toxic gases in industry. It is stated that, in high concentrations, benzene acts as a narcotic (acute poisoning). In low concentrations, over a prolonged period, it affects the blood and blood-forming organs of the body (chronic poisoning). Full details are given concerning the effects of different concentration of benzene vapour in air and methods of estimation.

Francois Cementation Co., Ltd., Bentley Works, Doncaster, Yorks, specialize in work under the recent Civil Defence Bill, and employers are recommended to get in touch with them regarding their A.R.P. requirements, particularly for deep shelters for their staff.

James Walker and Co., Ltd., "Lion" Works, Woking, Surrey, invite readers to write for their catalogue No. C3, which gives full particulars of their range of packings and jointings.

W. T. Henley's Telegraph Works Co., Ltd., Holborn Viaduct, E.C.1, have produced a new plastic compound which does not require the application of heat before it is used for filling joints or terminal boxes.

Alfred Herbert, Ltd., Coventry, have been appointed sole selling agents for T. H. and J. Daniels, Ltd., Stroud, Gloucester, to sell their well-known machines to the plastic industry.

Toxicity of Industrial Organic Solvents, Report No. 80, published by the Medical Research Council, Industrial Health Research Board, is an important addition to the works library. It consists of summaries of published work compiled by Ethel Browning, under the direction of the Committee, on the Toxicity of Industrial Solvents. The book deals in great detail with the complete range of industrial solvents, including the hydrocarbon group, the chloro compounds, alcohols, esters, cyclohexane derivatives, ketones, glycol group and various miscellaneous solvents, including carbon bisulphide, pyridine, ethyl ether and iso-propyl ether. As a reference book this report should prove invaluable, as it will enable the works manager in the cellulose lacquer, paint and other related trades to obtain vital data concerning any new solvent he may think of using. The latest scientific information regarding symptoms of poisoning and treatment of cases is also given.

Liverpool Plastic Co., Ltd., private company with a capital of £100, formed to carry on the business of manufacturers of, and dealers in, plastic goods, Bakelite, glass, metal, Xylonite, etc.

General Plastics, Ltd., is a private company, capital £1,000, with registered office at Albert Works, Spencer Road, Hornsey, N.8, formed to acquire the business of machinists and dealers in cellulose acetate, fibre, Bakelite and similar materials.

NEW MATERIALS—NEW PLANT—NEW METHODS

Cutting Oils for Tool Makers

The tool-making side of the plastic industry will, no doubt, be very interested in the following notes on cutting oils, supplied by Alfred Herbert, Ltd., Coventry, who have had considerable experience both in their use and manufacture.

During the past few years considerable attention has been given to cutting lubricants, not only to improve their cooling and lubricating properties, but also to prevent corrosion of machine tools.

While careful attention is paid to the efficient guarding of all sliding surfaces on machines, thereby giving protection against swarf and accidental damage and reducing wear by abrasion, all this may be nullified if the cutting lubricant is of unsuitable quality or is not used to the manufacturer's instructions. Certain types of emulsion, whilst being satisfactory in other respects, promote a considerable amount of corrosion of sliding surfaces, thereby causing as much, if not more, actual damage than normal wear and tear.

It is, therefore, important to use cutting lubricants which are free from doubt.

Cutting oils can be divided into two groups: Soluble oils and neat cutting oils.

Soluble Oils

These consist of a thin mineral oil and an emulsifier. To prevent the separation of water and oil when in use, a stabilizer is incorporated. This oil possesses great cooling power, enabling metal to be removed much more quickly than is possible with straight cutting oils. Surface finishes are usually better than those obtained by cheaper grades of straight cutting oils. Tool wear when using soluble oils is greater than when using straight cutting oils. Soluble oils should, therefore, be used only for the simpler types of tools, which can be reground easily and comparatively often.

A common cause of corrosion when using a soluble oil is often brought about by mixing the oil with a quantity of water in excess of the maker's recommendations. This is often carried out under the false impression that economies are being effected. Other causes are the separating of the water and oil or an accumulation of dirt and swarf in the sumps and pipes of machines. These points should be watched when using a lubricant of this type. Machines should be cleaned out occasionally, especially when changing from one grade of emulsion to another, as the mixing of two different grades frequently produces severe rusting.

In general, it can be said that soluble oil emulsions are suitable mainly for normal operations on capstan and turret lathes, where intricate and expensive tool layouts are not experienced. They are also especially suitable where the use of carbon steel tools is encountered, which, owing to their ability to maintain a keen cutting edge, are still to be found in use. As this type of steel softens very readily under heat, the cooling properties of the lubricant are a most important factor.

The modern types of hard carbide tool materials, such as Ardoloy, possess remarkable powers of resistance to heat and abrasion, rendering the use of cooling and lubricating fluids less necessary than with high-speed steels.

It is the general practice, therefore, to perform a large amount of machining dry, lubricants being necessary only when other tools, such as roller boxes, drills and die-heads, demand it. Here, again, the soluble oil emulsion is quite satisfactory.

Neat Cutting Oils

These consist of animal, vegetable or mineral oils, either alone or compounded to suit various classes of work. They are recommended where intricate and expensive tool layouts are used and where it is necessary to have a maximum tool life between grinds, as on all automatic and semi-automatic machines. They are also recommended for use on hobbing and gear-cutting machines and all operations where the tools are costly and any wear will affect the dimensions and finish of the machined product.

There is a tendency for straight cutting oils to fume when in use, forming a close, oily atmosphere around the machine. This can be minimized by using an oil having a high flash point, not less than 350 degrees F., and ensuring that there is a sufficient flow of oil over the tool cutting edge.

Neat oils possess the advantage over soluble emulsions in that they lubricate moving parts of the machine, such as slides and turrets, with which they come into contact. Any leakage into headstocks or feed boxes which contain lubricating oil can be ignored, as no deleterious effects can ensue and rusting does not occur.

Thus, a good brand of neat cutting oil prolongs the life of both tools and machine, and it can be said that the more expensive the machine the greater is the argument in favour of neat oil.

The following cutting lubricants are extensively used in engineering practice:—

Soluble Oils

Clear Dixol. Manufactured by W. B. Dick and Co., Ltd., 26, Grosvenor Gardens, London, S.W.1. This oil possesses exceptional freedom from corrosive action and has great stability and high dilution which ensures economy in use.

Sternopal Clear Soluble Oil. Manufactured by Sternol, Ltd., Royal London House, Finsbury Square, London, E.C.2. Recommended for grinding and general machine-shop use.

Where exceptionally hard water is encountered, it will be found beneficial to add 0.5 per cent. of common soda to the water before adding these soluble oils. This will precipitate calcium and magnesium salts, which otherwise combine with some of the emulsifying soap in the oil and appear on the surface as scum.

Neat Cutting Oils

Circol. Obtainable from Alfred Herbert, Ltd., Coventry. For general work on all automatics.

Super Neat Cutting Oil Q2951. Supplied by Alexander Duckham and Co., Ltd., Duckham House, 16-18, Cannon Street, London, E.C.4.

Frapol Index Neat Cutting Oil. Supplied by Edgar Vaughan and Co., Ltd., Legge Street, Birmingham.

High-tensile and tough steels which are now used, particularly in the aircraft industry where smooth finish and great accuracy are demanded, impose severe conditions on both tool and lubricant.

For threading and forming operations, both Q2951 and Frapol will prove satisfactory.

It is essential when using straight cutting oils to employ some means of disinfection, as these oils frequently cause dermatitis.

"Dibactol," supplied by Alfred Herbert, Ltd., is an effective disinfectant. It has a sterilizing action on the oil and reduces the risk of infection.

THE LESTER AUTOMATIC INJECTION MOULDING MACHINE

This is manufactured by the Lester Engineering Co., of Cleveland, Ohio, U.S.A., and handled in this country by Dowding and Doll, Ltd., Greycoat Street, London, S.W.1. The machine is exceptionally strong and the frame is made very largely of Mehanite and cast steel. An obvious departure in general design is shown by the fact that a frame construction has been preferred to the use of tie bars and a very considerable increase made in the strength and serviceability of the machine.

The platens moving on prismatic ways is an important departure characteristic of the design. The movable left-hand platen is supported in its centre by a large forged-steel drum, which is adjustable by a large-diameter Acme thread connecting it with the slide proper and adjustable relative to it by crank-actuated worm and worm wheel. This mechanism allows for the maximum ease in adjustment and is, at the same time, absolutely self-locking. This steel drum, moreover, supports the platen in its centre; that is, at the point where the platen is subject to the maximum strain. The right-hand platen, which does not move during operation, is of extra depth, is securely supported by the right side of the frame. It will, therefore, be obvious that a maximum of safety is provided as regards strength and rigidity for keeping the mould closed under the heaviest injection pressure. Referring briefly to the toggle system, it is claimed to be rather unique. Four pairs of two taper faces come to interlock one another when the levers are in the dead-centre position.

The self-locking wedge construction of the machine is a great advantage and there is virtually no friction to overcome when opening and closing the mould, because the swinging action takes place in an arc during the closing and opening of the mould. These taper faces relieve the pins from strain when the mould is closed and, theoretically, no pins would be needed for holding the mould closed, once the dead-centre position is reached. This results in the minimum wear on the toggle joint bolts, even after long periods of service, and it makes the secured locking independent of any wear factor. The lock faces are, incidentally, renewable should replacement become necessary after long periods of service.

The next outstanding feature of the design is the vertical arrangement of the injection cylinder unit. This, it will be observed, contrary to all other constructions, is arranged vertically, the cylinder terminating in a special internally streamlined knee-piece before terminating in the nozzle. Two very important advantages result from this design:—

First: Valuable floor space is being saved.

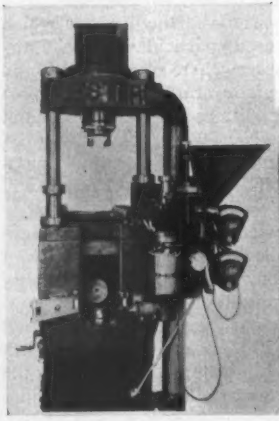
Second: The whole injection unit, comprising cylinder, hopper and feed mechanism, can be swung in and out of position with the greatest of ease and in a minimum of time, thereby giving convenient and free access to the nozzle and the rear port of the mould.

The swinging out of the injection cylinder unit and the replacing into securely locked working position can be effected within one minute. The design combines, therefore, the maximum of rigidity with the maximum of accessibility.

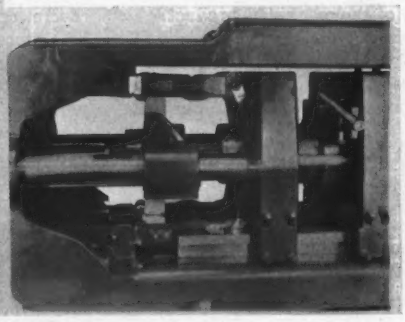
In designing the injection and heating cylinder proper, Lester have again departed from the conventional procedure. The piston is of the ring type and is extended to the top, where it engages in the tee slot fitting connecting it to the hydraulic injection pump. The cylinder does not contain the conventional torpedo-shaped body, but contains a cylindrical centre member surrounded by the ring-type piston on top and terminating in a point projecting towards the streamlined knee-piece. This centre member has a larger cylindrical portion with which it fits accurately into the vertical heating cylinder. The material is forced through holes in the resultant shoulder with streamlined entrances. The design consequently makes it impossible for material to lodge in odd corners and gaps between centre member and cylinder wall and precludes overheating of material remnants and resultant discoloration. After passing through these openings the material has been adequately heated and is safely merged into one stream which is then taken through the streamlined elbow piece into the horizontal portion and to the nozzle. Resistance heating elements with pyrometers are provided on the vertical and the horizontal portion of the cylinder, as well as on the nozzle, but, if desired, induction heating can be provided as an alternative.

The drive of the machine is electro-hydraulic, a standard floor mounting motor being employed, driving the double Vickers pump which gives the hydraulic power. An ingenious valve combination ensures that there is no slowing down of the injection piston when it encounters the main injection resistance. This ensures a smooth, powerful action, especially necessary for producing thin-walled and intricate mouldings. The time cycle can be set either fully or semi-automatic.

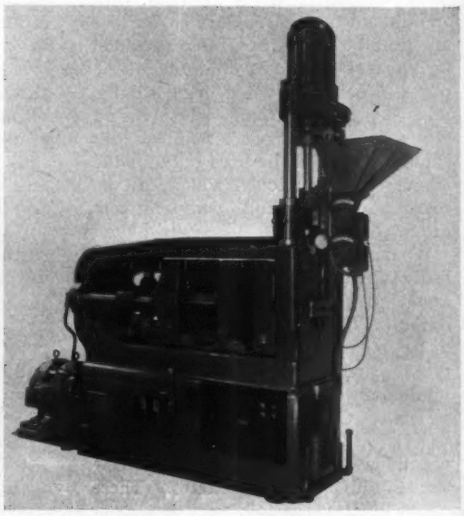
Below shows the injection moulding cylinder and closing device swung clear of mould.



Centre picture illustrates toggle lever mechanism.



Extreme right is the 4-oz. Model LPM-1.



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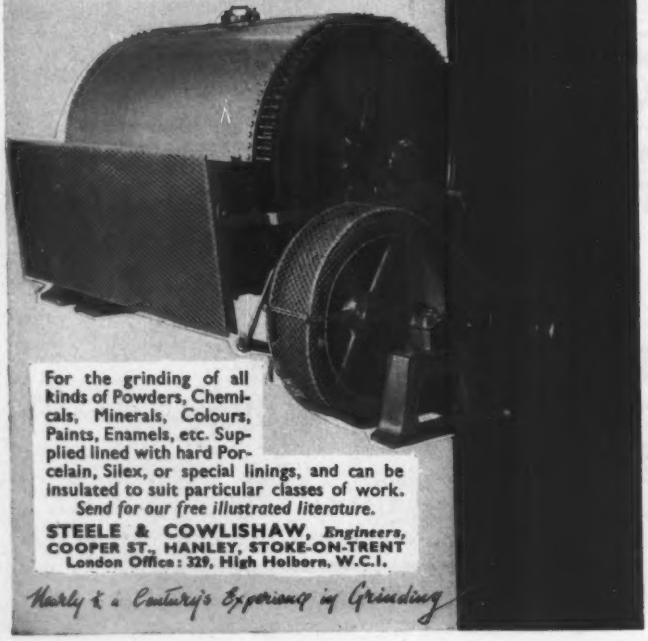

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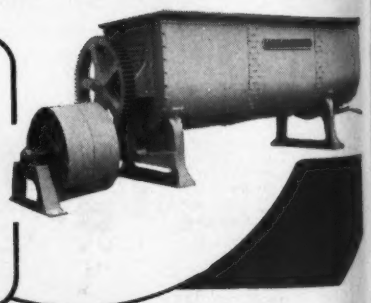

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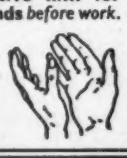

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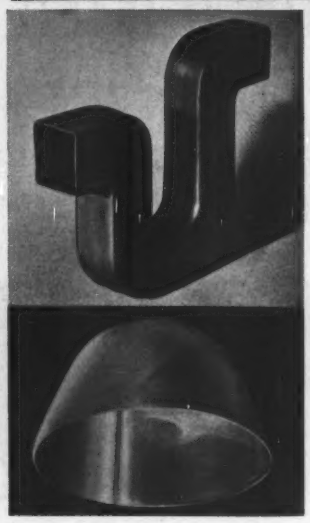

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